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The Coal Pile Will Bear Continued Watching

SHORTAGE of bituminous coal stares the electrical industry in the face again this year unless the authorities in Washington find a way to increase production. Early in the present year the indicated output of coal for 1918 was 36,000,000 tons less than it was last year and 72,000,000 tons less than it was the year before. The cause assigned for this tremendous falling off in production is car shortage. In handling coal at the mines the procedure has always been to load the output directly from the mines to the cars. If cars are not available, the mines shut down and production ceases. To store coal at the tipples would mean rehandling of the fuel as well as added expense, and besides there is no storehouse comparable to the seams where the coal is found in the earth. It is therefore apparent that, if a shortage is to be avoided, the mines must be kept in operation and every effort made to increase the output. The country needs and must have coal. It is no longer interested in the skill by which the blame is shifted from the coal operator to the railroads and from the railroads to the weather. There is ample time between now and next winter for the Fuel Administration and the railroad director to co-ordinate their work, if they will, so that there shall be no recurrence of the coal famine of 1917. Public utility companies meanwhile should heed the warning which the present situation foreshadows and make every effort to get and to store coal.

Higher Salaries Needed by Engineering Profession

IN THESE days of increasing costs the engineering profession finds itself between the devil and the deep sea. Most engineers are under salary, and we have not discovered any acute symptoms of rising remuneration in this particular line of activity. The comparatively small number of engineers in independent practice can, of course, protect themselves by raising their fees on their own initiative; but they are too few to change the general situation with respect, let us say, to the average members of an engineering society. The long and short of the matter is that the salaried man, whether in a technical position or doing purely commercial work, finds himself "up against it." Perhaps, as Mr. Schwab intimates, the end of the war will find the country in the hands of the workingmen. However this may be, the class of workingmen who use instruments rather than ordinary tools seem likely to be left out of the reckoning. Undeniably the present situation is extremely hard on a large proportion of the engineering profession, and the general principles of fair play would seem to indicate that engineers should have a share in the upward movement of compensation demanded by carpenter, machinist, steamfitter and ditch digger. The engineering profession is not unionized, nor even well organized on an individualistic basis, as is the medical profession, in which there has been a very general increase of fees. Neither does it possess, through numbers and system, a powerful influence in the matter of votes. Nevertheless, the gospel of the square deal certainly calls for better compensation than at present rules. To meet the serious demands upon them engineers need larger financial recognition.

Make Your Plans for Third Liberty Loan Now

APRIL 6 is the date set for the campaign to place the third Liberty loan. Manufacturers, central stations and other employers of labor have a special opportunity to enlist their organizations in this army of investors for national service. The general purposes of the loan and the opportunity it offers for every stay-at-home to do his part in the establishment of new ideals for the world will be found in posters, magazines and newspapers. What is most needed, and this is what the practical business men of the industry can supply, is that every business organization form itself now into a branch collection agency for the government. The campaign will be short. Organization within each plant should be perfected now so that bonds can be sold to every one in the organization, from the company and its officials through to the least important member. In subsequent issues the ELECTRICAL WORLD will publish plans and methods successfully adopted by electrical companies. Later in March a special colored poster will be distributed with the paper in addition to an advertising insert contributed by the publisher and by the electrical manufacturers and devised in such a way that the posters that compose it may be placed on office and factory bulletins the country over. That the contributions of the industry may be recorded as completely as possible, the ELECTRICAL WORLD will be glad to receive at once accounts of plans that individual readers already have under way.

Graphical Determination of Line Constants

IN THE case of a simple alternating-current circuit containing in series a condenser and a resistive inductance the alternating current in the circuit may be taken as the same at any instant in all parts. That is, the amperes in the condenser are the same as the amperes in the inductance. The strength of the current is obtainable by Ohm's law, using impedance expressed in complex quantities. When, however, an alternating-current circuit comprises a line or lines possessing distributed resistance, inductance, capacitance and leakance, the current strength is not the same at the same instant in all parts of the circuit. In particular instances the current may be strong and flowing toward the generator at one point on the line, while at the same instant it may be very weak and flowing away from the generator at some other point in the line. In a long line, worked at a fairly high frequency, both the voltage and current may pass through a number of successive maxima and minima, and also through several reversals of direction, as we consider different parts of the line at one and the same instant. It is evident that Ohm's law ceases to be applicable to such a circuit in the ordinary sense. A new law, however, comes into application. In the steady state of alternating-current flow each and every point on the line possesses a certain complex hyperbolic position angle, which increases steadily and continuously with distance toward the generator end of the line, so long as the electrical constants of the line remain uniform, but which undergoes a simple sudden change when a transition occurs from one type of line to another, such as in changing from underground cable to overhead aerial line. The alternating-current strength at any point on the line is then directly proportional to the cosine of the position angle, and the alternating voltage to the sine of the position angle. Knowing the current and voltage at any one point in the circuit, such as the generator end, the current and voltage at any and all other points are immediately determinable by simple proportion, with the aid of existing tables or charts of hyperbolic sines and cosines. The impedance and the power are likewise simple hyperbolic functions of the position angle.

In his article this week T. A. Wilkinson describes an alternative method of deriving the voltage and current at the terminals of a transmission line, based on fundamental hyperbolic functions, but evaluated through the specially prepared charts which accompany the article. By using the vector formulas given at the beginning of the article, the six quantities a_1, a_2, b_1, b_2, c_1 and c_2 appearing therein are easily obtainable from the charts, so that the solution follows without difficulty. Since these charts have been carefully drawn, they will be of permanent value, as affording one method of solving any such transmission-line problem.

In the particular arithmetical case presented in the article the length of line is taken as 250 miles (402 km.). This would be a long power transmission line, and yet the effect of taking the distributed capacitance into account by correct methods such as that offered is only a few per cent as compared with the result obtainable with the split-condenser method, in which half the capacitance of the line is assigned to a condenser applied at each end. At frequencies up to 60 cycles per second the effect of distributed capacitance is relatively unimportant on split-condenser computations up to transmission distances such as this. When, however, higher harmonic frequencies are considered, or in telephonic transmission problems, hyperbolic-function methods become absolutely indispensable to the engineer.

Good Practice in Cooling Transformers

IT WAS not so very many years ago that electrical apparatus was designed to run cool merely in virtue of abnormally low energy losses obtained at absurdly high costs of material. It took a long time to inculcate the lesson that the economics of the situation involved far more than I^2R losses. So, gradually, scientific cooling has rid us of more and more heat, and this gain is taken in the form of increased output for a standard rise of temperature rather than fruitlessly as low temperature at standard output.

We have seen no neater demonstration of practical conditions than in Claude H. Shepherd's description of the forced cooling of transformers in a Chicago substation, published in this issue. The starting point was an ordinary three-phase reducing transformer which, owing to heavy load in an abominably hot transformer room, increased in temperature enough to imperil the insulation. Oil at 75 deg. C. and a room at 60 deg. C. form a bad combination. Now, there are in more or less common use three types of transformers, air-cooled, self-cooled oil-filled and water-cooled oil-filled, of which the first is becoming rare, the second is extremely common, and the last, generally provided with cooling coils in the case, is not infrequent in heavy substation work. Mr. Shepherd's feat was to convert the second into the third type by tapping the case and pumping the oil through a cooling system, a simple enough thing to do, but rather better in its results than would at first be supposed.

The so-called self-cooled transformer is quite unexceptionable in small sizes or in the open air where the large cooling surface of the case can be well utilized. But in a superheated transformer room with the usual poor ventilation there is quite another story to tell. The net result in this instance of circulating the oil was to increase the practicable output by 60 per cent and to effect an actual saving in operation big enough to show about 37 per cent on the added investment. Obviously any fairly big transformer can be treated in this manner, the chief matter requiring attention being the arrangement of the intake in such wise as to keep all the hot oil moving. As Mr. Shepherd suggests, a copper cooling coil would be desirable as giving better results with less work in pumping and perhaps with increased output. At all events, the gain in practicable rating proved to be so great as to leave a large reserve capacity in other transformers likewise treated.

In these days of high costs and slow deliveries anything which can avert additions to the plant is worth while, particularly when simple and economical. In ordinary substation working there is no particular trouble in operating an oil-cooling system, and in out-of-doors substations there is generally little need of it. Cooling the oil by circulation through external coils is likely to be decidedly more efficient than the reverse

process of pumping cooling water through coils in the case, since in the first instance a large cooling surface is the more easily provided and the real condition of the oil is easier to ascertain.

Lessons from Steam-Turbine Accidents

ONE of the most serious accidents in the history of steam-turbine development so far as material damage is concerned occurred about a month ago in a generating station of the Boston Elevated Railways. It involved the wrecking of a 35,000-kw. machine with very large damage but fortunately no loss of life. Some of the circumstances of the occurrence are worth noting, as they throw a great amount of light on necessary lines of improvement in building turbo-generators of colossal output. In many lines of machine design mere size does not have to be very seriously considered as a factor in the problem. In case, however, of steam turbines and other fast-running mechanisms in which the factors of safety have to be very carefully considered the influence of dimensions sometimes turns up in unpleasant and unexpected ways. Trouble in the Boston turbine occurred at the low-pressure end in which cast-iron diaphragms were used. As nearly as can be learned from the data at hand, the eighteenth diaphragm buckled, fouling the blades on the corresponding runner and tearing them off. Immediately the next diaphragm gave way, involving the nineteenth wheel, and then the last diaphragm and wheel were affected, ending by tearing open the casing from the immense centrifugal force of the flying pieces.

The circumstances which led up to the accident give important hints as to causes and remedies. Exactly a year prior to the present accident the eighteenth diaphragm deflected in the trial runs, fouled the buckets of its runner and stripped them, likewise damaging the succeeding diaphragm and runner. The throttle was tripped when the buckets began to rub, but the mischief was already under way and promptly followed. Repairs were executed, and the machine did its duty up to the present catastrophe. In this instance the immediate cause of the trouble appears to have been a blow-out in another station which dropped its load of 10,000 kw. and threw it practically in its entirety on the fated turbine. This automatically opened its secondary valve and suddenly and greatly increased the steam pressure in the low-pressure stages, probably thereby causing the distortion of the eighteenth diaphragm which began the trouble. The first sign was rubbing and vibration. An attempt was made to adjust the thrust bearing, but things began to happen inside the casing, the operators wisely took to cover, and in a very brief period the damage was done. How much power was actually thrown on the machine already carrying 32,000 kw. is uncertain, but whatever the load it came on like a battering ram.

The exact details and consequences of the smash-up may perhaps never be known, but some of the morals suggest themselves immediately. First, it seems reasonable that caution should be taken, as in any machine alread subject to high strains, to avoid the shock of a sudden impulse. Less speed in the operation of the secondary valve would have dropped the frequency a little and perhaps would have averted the shock that wrecked the turbine. Attempts to force a heavy overload on a machine already close to its rating have to be made with great caution. A sudden short circuit is liable to occur on any system and it is better to yield in load than to run the risk of damage. Further, it looks very much as though cast iron cannot always be considered a suitable material for diaphragms in a machine of these dimensions. In principle it is amply strong—in fact, careful calculations in the case of this particular turbine showed as much—but it is at best a somewhat treacherous material, as many accidents have shown, particularly when subject to sudden and violent strains. A peripheral speed approaching 1000 ft. (328 m.) a second causes even the least rubbing to be serious and to add dangerously to the other strains on the system. Fortunately the throttle was tripped in the course of the proceedings, either semi-automatically by one of the retreating crew or by the vibration itself; otherwise more serious results might have occurred. It would not be impossible to provide for the automatic tripping of the throttle in case of a sudden increase in the differential pressure between the stages, but whether this precaution is desirable is a matter to be left to the turbine designer. Such accidents as this serve notice on the manufacturer and user that in the gradual development of very large sizes critical situations develop, as part of the necessary growth of the art, which eventually may call for material changes in practice.

Certain it is that in this case a serious accident occurred not because of physical faults in the material or incorrect general principles of design, but rather owing to the imposition of sudden strain under conditions which might conceivably have been better controlled and which developed a weakness not ordinarily to be expected in the operation of generating stations with the equipment of the one in question.

The Coming Issues

IN THE course of investigations to develop a method of increasing the carrying capacity of underground cables a Middle West company has studied the effect of filling the space between cables and their inclosing ducts with crude vaseline. Some very promising results have been obtained which will be presented in a coming issue of the ELECTRICAL WORLD. Since numerous improvements have been made in synchronous motors which make them suitable for many services to which they formerly were unadapted, an article in an early issue will point out just what modern synchronous motors can and cannot do, giving some examples of actual installations. Among other subjects which will be discussed in the future will be important changes that have been made in factory-lighting legislation and the best methods of measuring the internal temperatures in generators. In next week's issue the presentation of the views of L. K. Comstock, advocating the payment of wages in the electrical contracting industry in accordance with index numbers indicating the cost of living, will be concluded.

Raising Wages with Cost of Living

A Plan for Paying Workers in the Electrical Contracting Industry on the Basis of Living Cost as That Cost Is Indicated by Index Numbers of Responsible Commercial Organizations

BY L. K. COMSTOCK

Mr. Comstock is in close contact with the practical problem of labor and is giving it thoughtful consideration so that wages may be made commensurate with living cost. He presented his advanced views recently before the Conference Club, an organization of the larger "interstate" electrical contracting organizations. They will be published in two articles in the ELECTRICAL WORLD. This one discusses generally the principles involved. The second one, to appear next week, will show the application.

NO PROBLEMS confront us oftener than those arising from the relation of employer and employee. In fact, this relationship is probably the most important one that engages the attention of the business and industrial world, and transcends in importance the problems now being solved on the battlefields of Europe, although perhaps inextricably mingled with those problems.

We as citizens of the United States, whether we belong to the ranks of labor or the employers of labor, have been derelict in our duty, because we have negligently or deliberately refused to look intelligently into this problem, to seek out the facts of human nature involved, and to be guided by what could have been found. The prejudices and traditions of the past still linger to make the employer look upon labor, not in the spirit of co-operation, but in the spirit of the master toward the servant.

On the other hand, centuries of tradition and prejudice have made the laboring man, the mechanic, look upon his employer as a man to be feared and hated. He has had perhaps a just cause for his servile attitude. But in these modern days of democracy and unions he has felt his strength and has endeavored to obtain by force what he thought he wanted and could get, because he knew no other way. There have been many exceptions, of course, to the general rule, and many employers for generations have had the best of relations with their employees.

Opportunism Versus Logic

I think it may be stated without fear of contradiction that these problems taken in the mass have drifted toward temporary or opportunist solution rather than yielded to the power of reason and logic. Most labor disputes in the past have been tinged with anger on one side or the other and generally on both sides, or they have been regarded as sporting events in which the contestants have played for the stakes for sheer love of the game. A labor dispute hardly rises to the dignity of the term unless accompanied by a strike or a lockout; in either of these cases both sides lose, a circumstance readily producing anger, and therefore usually an unjust settlement, divesting the game of its sporting character.

In discussing "war and human progress" Viscount Bryce points out the distinction between two schools of philosophical thinkers or historians. One of these schools emphasizes "the power of reason and of those higher and gentler altruistic emotions which the development of reason as the guide of life tends to evoke and foster" and finds in these tendencies "the chief sources of human progress in the past and expects from them its further progress in the future." This school regards men "as capable of a continual advance through the increasing influence of reason and sympathy," and dwells upon "the idea of justice and right as the chief factors in the amelioration of society."

The Argument Based on Human Selfishness

The other school, less optimistic, insists "on the power of selfishness and of passion, holding these to be elements in human action which can never be greatly refined or restrained, either by reason or by sympathy, that social order can be secured only by force—right itself can only be created by force," and that "it is past force that has made what men call right and law and government."

The tendency of this second school is "associated with the less rational element in man—with passion and the self-regarding impulses which naturally attain their ends by physical violence."

The conflict between these two philosophies which Bryce finds is the fundamental provocative of the great world war thoughtful persons find also is the fundamental provocative of industrial conflict.

Boiled down, these two schools of thought can be described as the forward-looking and the reactionary schools. The former builds on faith and the latter constructs its edifice out of the old materials of the past.

After incalculable losses to both employer and employee through many years by reason of strikes and lockouts, it would seem that the time had arrived for these two parties to apply to their differences some degree of intelligence, common sense and sympathy. The union mechanic cannot get along without his employer, nor can his employer get along without his mechanics. This being so, why is it not the part of common sense to admit it frankly and work peaceably in team harness? Let the employer study sympathetically the needs and requirements of his men and likewise let the union see to it that the men work faithfully and sympathetically for their employers.

One of the principal indications of an impending shift in the front of the labor movement in this country is found in the fact that many of labor's foremost spokesmen admit that in increased production lies one of the most hopeful routes to a higher social and economic status for those who work with their hands. In several recent reports—largely influenced by the American Federation of Labor—where this question of the effect of increased production was distinctly raised, labor's representatives refused to oppose increased production as such. This is a far step from the "soldiering" recently openly advocated and practiced.

It may be argued that trade union activity in the

direction of curtailing output, restrictions on apprenticeship and its successful demands for shorter hours has made a real contribution toward increased cost of living. This argument is generally believed by certain classes of employers. Let us examine the available data on this subject. The federal bulletin on wholesale prices in 1913 cites twelve important food, fuel and

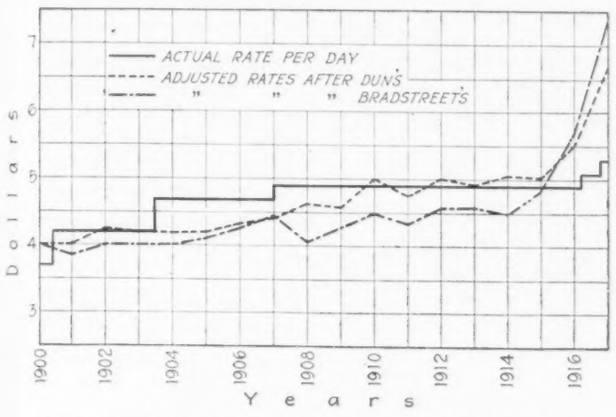


FIG. 1—RELATION OF ACTUAL RATE OF DAILY PAY TO RATES BASED ON RISING COST OF LIVING

shelter articles which on the average showed a price range for the year 1913 more than 60 per cent higher than their price range for the period from 1890 to 1899. The whole 252 articles listed in the bureau's bulletin showed a price rise for the same period of only 35 per cent. It should be stated that eleven of the twelve articles above mentioned were produced by farmers, ranchers, timber men and oil workers. These groups of workers are not organized into unions and yet the commodities they produced show a price rise 70 per cent greater than that of average goods. Apparently organized labor exactions do not account for this great rise in eleven staples.

The great trouble seems to lie in the fact that collective bargaining is conceived in terms of unionism, closed shop and walking delegates, and there does not seem to be a comprehension of the fact that a compromise exists which will safeguard the rights of the employer and worker without injustice to either.

THE OLD METHOD OF BARGAINING NOT THE ONLY ONE

Union leaders have expended their energies in the past, ostensibly at least, to gain higher wages and better working conditions. Employers have with the greatest reluctance yielded in these two sets of demands when their intelligence should have dictated an early and willing acquiescence. By this statement I do not mean to imply a servile acceptance on the part of the employer of any demand, but I do wish to convey the idea that if the employer had earlier recognized the right of employees to unionize, had earlier perceived that the time had come or was at hand when public opinion would support the union demand for a larger and a fairer share in the fruits of his labor, then union labor would have naturally cultivated a more sympathetic attitude toward employers and the dishonest labor leaders would have been robbed of their opportunities for grafting.

We talk of open shop and closed shop as though we were entitled to choose under which emblem we desire to conduct our operations. In a limited sense we have this right, but it is well to bear in mind that the right of employees to strike for any cause or for no cause is sustained by the common law everywhere in the United States, and that agreements among strikers to take peaceable means to induce others to remain away from the works of an employer until he yields to the demands of the strikers are not held to be conspiracies under the common law, and the carrying out of such a purpose by peaceable persuasion and without violence, intimidation or threats is not unlawful. Many of the labor disputes which have reached the courts have been decided according to the common law, but twenty-three states and the federal government have laws or constitutional provisions for arbitration and conciliation, although the federal statute applies only to common carriers engaged in interstate commerce.

Much of our trouble with labor has arisen from that ever-recurring attempt to adjust the wage question. I think it within the limits of truth to say that this question is rarely if ever settled equitably. It is settled usually only after a strike and protracted negotiations, and then without any particular reference to the equities of the case. The side on which the ablest or most stubborn negotiators sit wins out. Such settlements are innocent of scientific considerations of adjustment, and the hidden designs of the negotiators cannot stand the test of daylight.

It can well be admitted that labor is constantly demanding higher wages; the employer as constantly resists; one or the other must give way or a deadlock ensues, and bitterness, perhaps violence, results, with loss to all concerned. A just and scientific consideration of the facts should point the way to any readjustment of wages. Is it not worth while and certainly expedient to inquire, when wage readjustment is demanded, whether or not the facts support such a readjustment?

Wage earners must receive something more than the cost of their support, because if this were not so it would be impossible for them to bring up families and the race of such workmen would not outlast a generation. It would appear, then, that the employer, from purely selfish motives, must take intelligent cognizance

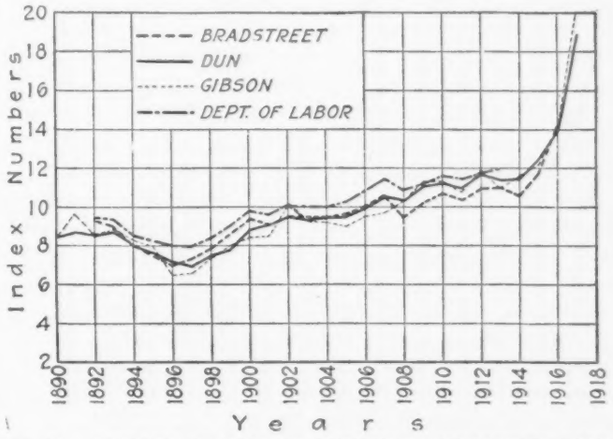


FIG. 2—INCREASES IN COST OF PRINCIPAL COMMODITIES FROM FIGURES COMPILED BY VARIOUS AUTHORITIES

of the relation between cost of living and rate of wages. As the cost of living rises the rate of wages must advance with equal increments, in order to maintain the relative position in the economic world of the wage earner. No one will deny the correctness of this theory —it remains, then, to find a practical method of its application.

Watch Your Radiation Losses to Help Save Coal

Heat Losses from Uninsulated Surfaces Great Enough to Demand Attention—Principal Characteristics Needed in Heat Insulation—Thickness Required and Other Practical Considerations

BY AUSTEN BOLAM

WHILE "bright lights" have been dispensed with, workless days tried, so-called unnecessary industries limited in their use of power or fuel, and such equipment as feed-water heaters, economizers, scale removers, soot blowers, CO_2 recorders, water and steam meters used more extensively than ever to conserve fuel and utilize it more efficiently, heat insulation and heat loss through radiation have not received the attention they deserve. Loss of heat from uncovered or poorly covered steam piping or equipment is more important than it seems on first thought, because the boiler and furnace efficiency must be taken into account. In other words, if condensation occurs it means that the equivalent loss is equal to the superheat plus the latent heat divided by the efficiency. If the condensate is not drained back into the boiler, the heat required to raise the water to the boiling point is also lost. If the efficiency of steam generation is low, say 50 per cent,

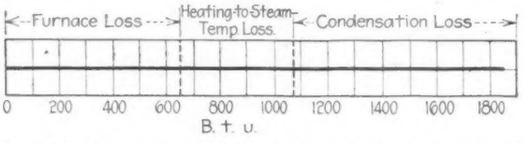


FIG. 1—COMPONENTS OF TOTAL LOSS RESULTING FROM UNCOVERED PIPES THROUGH CONDENSATION OF 1 LB. OF STEAM AT 150 LB. PRESSURE

it means that the actual loss is really twice the apparent loss.

Many steam plants have their main steam lines covered with insulation of some kind, but it is a very common practice to omit the coverings on valves, flanges, drips, feed pipes and other minor fittings, often because of a fancied difficulty in providing easily removable coverings. They are also great heat wasters, however. The amount of heat, for instance, wasted by one pair of uncovered 10-in. (25.4-cm.) flanges will probably amount to a ton of coal a year. Removable covers are easily made with a little fine chicken wire and some canvas, burlap or muslin, covered with plastic insulating material. They can be made in halves or sections and held in place by wire wrapping. Boiler tops, ends, drums, breechings and walls all need proper insulation. In the latter instance it will protect against air infiltration as well as from heat loss. A thickness of from 2 in. to 3 in. (5.1 cm. to 7.6 cm.) of covering is the least that should be used.

Writing[1] several years ago, Professor MacMillan said: "The saving due to the use of proper covering is so great that . . . the cost per year rather than the first cost should be the only consideration." In another place he said: "It is a deplorable fact that few steam lines at the present time are provided with thick enough coverings for the greatest net saving." Conditions have not changed appreciably since then, as lack of knowledge regarding the insulating values of different substances and the extensive amount of guessing at the thickness of covering required indicate. Coal consumption is responsible for from 55 per cent to 75 per cent of the total operating expense of the average power plant or central

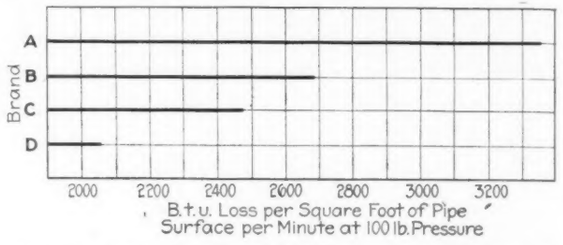


FIG. 2—RELATIVE EFFICIENCIES OF FOUR BRANDS OF PIPE COVERING

station. Therefore economizing in any portion of this enormous consumption is well worth the effort.

FALLACY OF RULE-OF-THUMB METHODS

In some cases engineers have decided on the thickness of pipe covering to use by feeling the covering after one thickness has been applied. If too hot, another layer is applied, and so on. Rule-of-thumb methods like this should be abandoned, since no two hands sense temperature alike and the hand can bear a temperature of 150 deg. Fahr. (65.60 C.) without discomfort. To illustrate the loss which can occur if only the touch test is applied for determining insulation efficiency suppose the steam pressure is 100 lb. (7 kg.). The temperature of the steam, without superheat, would be 327 deg. Fahr. (163.9 C.), so that with a temperature of 150 deg. (see above) at the outside surface of the covering the loss would be 40 per cent of the initial heat in the steam, most of it preventable by a covering of sufficient thickness.

Unfortunately there is extensive misinformation re-

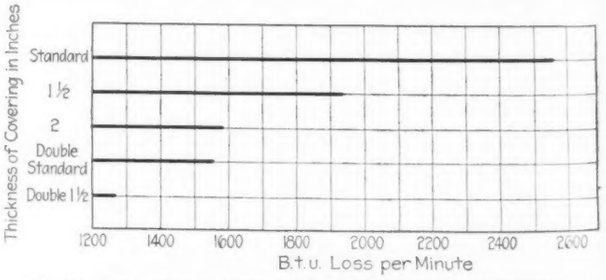


FIG. 3—RELATIVE LOSSES WITH DIFFERENT THICKNESSES OF COVERING

Temperature difference between air and steam, 300 deg. Fahr.; size of pipe, 3 in. Data from Armstrong Cork & Insulation Company.

garding the heat-insulating values of different materials, as a number of engineers seem to think that asbestos is a heat insulator, whereas it is a very poor material for this purpose except as a binder. There are many so-called pipe coverings on the market that are

[1] *Proceedings A. S. M. E.*, December, 1915.

worthless for anything more than the temperature used for ordinary house-heating, but they are being used in many large installations because they seem inexpensive and after they are on the pipes they look well. That there are no established standards of insulation practice is due largely to the fact that the coverings are commonly bought on a price-per-foot basis instead of on a cost-per-year basis. Competition between different makers is severe, and the temptation to unscrupulous competitors to cut prices at the expense of quality is obvious.

DURABILITY AND EFFICIENCY ESSENTIAL

On the other hand, the highest-priced insulation is by no means necessarily the most efficient. Without some knowledge of the theory of heat insulation comparison of different grades of material is impossible. The value of a heat-insulating material depends entirely on two co-essentials—efficiency and durability. Price is a minor consideration. If a covering will save its own cost in the first few years and will continue doing this as long as the plant lasts, it is a good investment. If

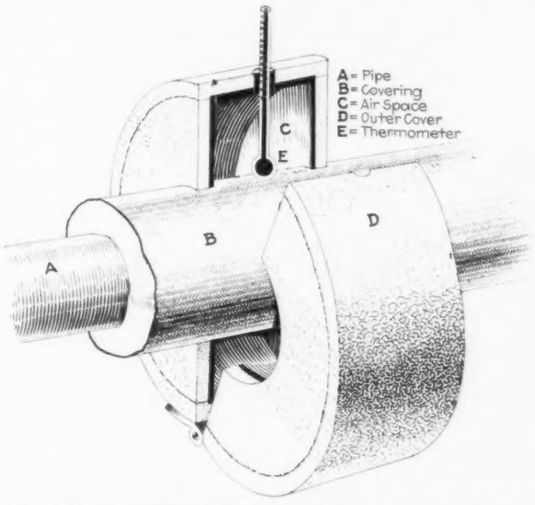


FIG. 4—SIMPLE OUTFIT FOR TESTING HEAT LOSSES FROM PIPES

Removable ends are provided to fit different-size pipes. The ends and periphery are covered with 85 per cent magnesia to prevent escape of heat. From the thermometer readings obtained the heat loss can be calculated.

it falls below this standard, it is dear at any price. There are some materials that will show great efficiency for a short period, but begin to deteriorate rapidly.

No pipe covering is 100 per cent efficient, but there are some that show an efficiency of from 80 to 90 per cent, the actual figures varying according to the thickness, etc. It is quite possible to reach and maintain the larger figure by proper selection and application. In order to set up a standard of comparison, what is perhaps the best-known and most universally used insulating material will be considered—85 per cent magnesia—because it complies almost entirely with all the requirements of a perfect heat resistant both in structure and in efficiency. This material consists of an almost pure crystalline carbonate of magnesia combined with a proportion of mineral fiber (asbestos) to give it the needful structural strength. Its structure is minutely porous, the crystals of magnesia embedding between their walls an extremely large percentage of dead air. In fact, these air cells comprise by far the greater part of the material, each one hermetically sealed and so minute that millions of them are contained in a single square foot of the insulation.

A necessary consequence is that the substance itself is extremely light in weight relative to other substances. A heavy, dense material cannot possibly be a good insulation, nor on the contrary can one whose structure is so light that the air spaces visibly make up the greater part of the bulk. The general rule may be laid down that large air spaces permit circulation and therefore cannot have real insulation value.

Owing to the tremendous desiccating influence of the long-continued heat on the insulation, organic substances are necessarily barred. Otherwise there are many materials of this class that would make efficient insulating coverings.

Taking bare pipe as a standard for comparing radiation losses,[2] it can be easily calculated that from each square foot there is roughly a heat loss of 51.7 B.t.u. per degree difference of temperature per hour, or with a steam of 150 lb. (10.5 kg.) a net loss of at least 1½ lb. coal per square foot of pipe per hour, or 36 lb. per twenty-four hours. This loss is continuous as long as there is steam in the pipe and is equivalent to more than 7 tons per year per square foot of pipe. This is an extreme instance, but in so far as it is the practice to allow any kind of steam pipe or feed pipe to remain uncovered, so far do these extreme figures apply. A very few feet of uncovered or badly covered pipe will therefore waste considerable coal.

"Standard" thickness covering is intended for pressures up to 100 lb. (7 kg.) only. Above that point extra coverings are required up to the maximum temperature of about 600 deg. Fahr. (315 deg. C.), which represents the highest practical temperature in modern steam practice. Figures taken from the standard specifications of the Magnesia Association follow:

Steam Pressure (Lb.)	Thickness of Coating.
Up to 100	Standard.
100 to 150	Double standard.
Over 150	3 in.
With superheat	3½ in.

Any engineer can readily compare his own insulation with these standards. If it falls short of these thicknesses, he is probably wasting a good deal of valuable heat.

HEAT INSULATION FROM AN INVESTMENT POINT OF VIEW

When the late Henry G. Scott made what is perhaps the only series of actual tests ever conducted by a user of insulating materials, he pointed out that the following factors should be taken into consideration in selecting heat insulation if satisfactory service is to be expected:

(1) Investment in covering; (2) cost of coal required to supply lost heat; (3) 5 per cent interest on capital invested in boilers and stokers rendered idle through having to supply lost heat; (4) guaranteed life of covering, and (5) thickness of covering. He further says: "It is apparent that the covering which shows a minimum total cost under the first three headings is the best covering to adopt, for the loss of heat at the end of ten years may readily cost more than three times as

[2]Steam pressures and superheats such as are used in ordinary central-station and power-plant practice are considered. These remarks are only partly applicable to heating or other low-pressure work, or to the use of furnace or other forms of heat reaction.

much as the first cost of the covering." That his conclusions were justified is indicated by the fact that the original (85 per cent magnesia) coverings selected by him are still in use.

In considering the investment value of an insulation durability naturally assumes importance. It goes without saying that the most durable covering will pay best, provided that it is equal in initial efficiency to others under consideration. This point demands greater attention than it often receives, because once the pipes are covered it may be years before they are disturbed again. A poor covering may have lost its efficiency in a short while, but because there is nothing to show this externally it will continue to waste heat for many years or even until the pipes are worn out.

Following is a simple formula which will assist in determining the most economical covering for any given class of service, whether temporary or permanent $(c - a/b)b = d$. In this equation c is the value of the coal saved per year, a is the cost of the covering, b is its life in years, d is the gross return on the investment in the covering.

Thus taking the cost of 100 ft. (30.4 m.) of covering as $80, assuming its life as fifteen years, and considering that during that time 25 tons of coal at $4 per ton are saved per year owing to the covering, the gross return on the investment will be $(100 - 80/15)15 = \$1,420$ per 100 ft. of covering.

For comparison consider the cheapest kind of pipe covering, costing $40, with an estimated life of five years. Assume that the coal saving is 60 per cent of that obtained with the better covering mentioned in the preceding paragraph. Then the gross return will be $(60 - 40/5)5 = \$260$, instead of $1,420 with the better covering.

In applying this formula to actual practice it must be borne in mind that what is meant by "lifetime" is the efficient lifetime of the covering, during which it will give its maximum service — and not merely the time it will stay on the pipes without falling off.

ELECTROMAGNETIC CONDENSER FOR POWER-FACTOR REGULATION

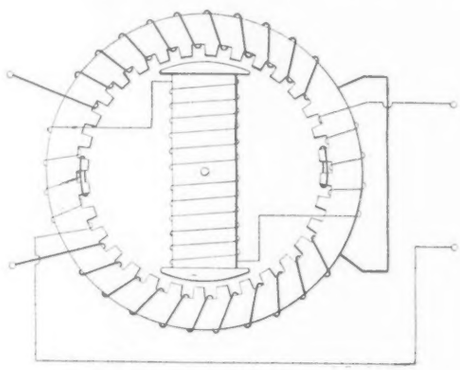
One Winding of Dynamo Is Inserted in Alternating Current Circuit, the Other Is Excited from Source of Direct Current

Prof. Gisbert Kapp of Birmingham, England, in patent No. 1,236,716, assigned to the Westinghouse company, suggests the use of an electromagnetic condenser to correct for the power factor of inductive apparatus in an alternating-current system. According to the inventor, a dynamo-electric machine wherein either the stator or the rotor winding is inserted in the alternating-current circuit in which it is desired to adjust the power factor is employed, and the remaining winding is excited from a source of direct current.

The rotor of the machine is therefore oscillated in synchronism with the frequency of the alternating current, absorbing energy from the latter portion of each current wave, storing the energy in the form of momentum, and recuperating the energy just before and upon the first portion of the succeeding wave. The phase of the resultant current wave may be made to approximate that of the attendant voltage wave as closely as desired.

The stator winding is, for the sake of simplicity, shown as a ring winding, but a drum winding may be employed. The iron core of the stator carries an alternating current winding. A bar magnet is pivoted and provided with a direct-current winding, which latter may be put in series with the direct-current winding on the stator. The pole pieces of the magnet are so shaped as to sweep as closely as is mechanically possible in front of the stator winding. By this construction, with a given field excitation, a magnetic field of maximum strength is obtained. The object of the series winding is to secure to the magnet a zero position and to prevent it from vibrating through a greater angle than 90 deg. from the zero position.

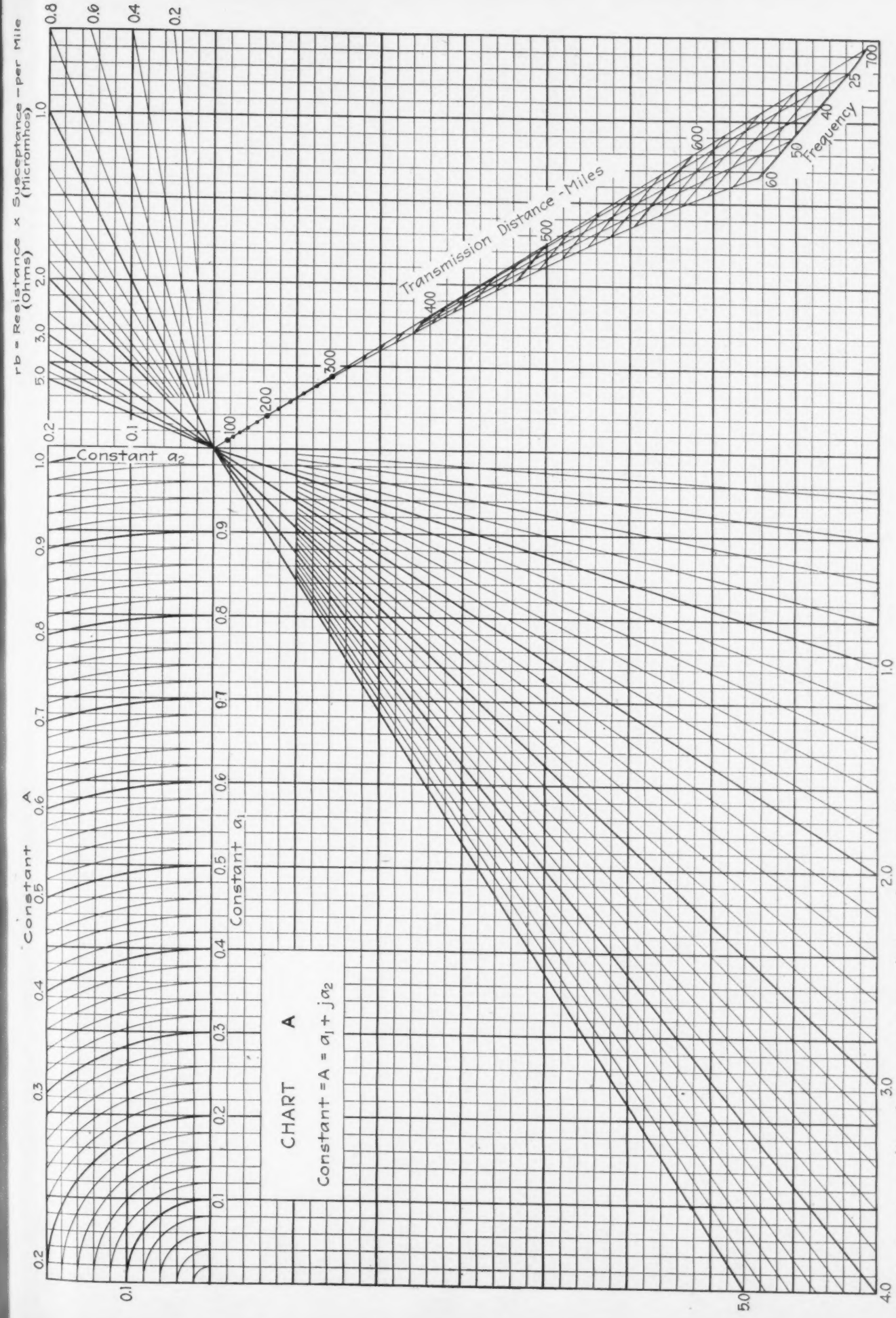
So long as no alternating current is sent through the stator the vibrator will remain at rest in such position that its magnetic axis will coincide with the magnetic axis produced in the stator by its direct-current winding. If an alternating current of the low frequency of the slip is passed through the stator, the bar magnet is acted upon by mechanical forces that alternate in direction with the alternations of the current, and is thus set

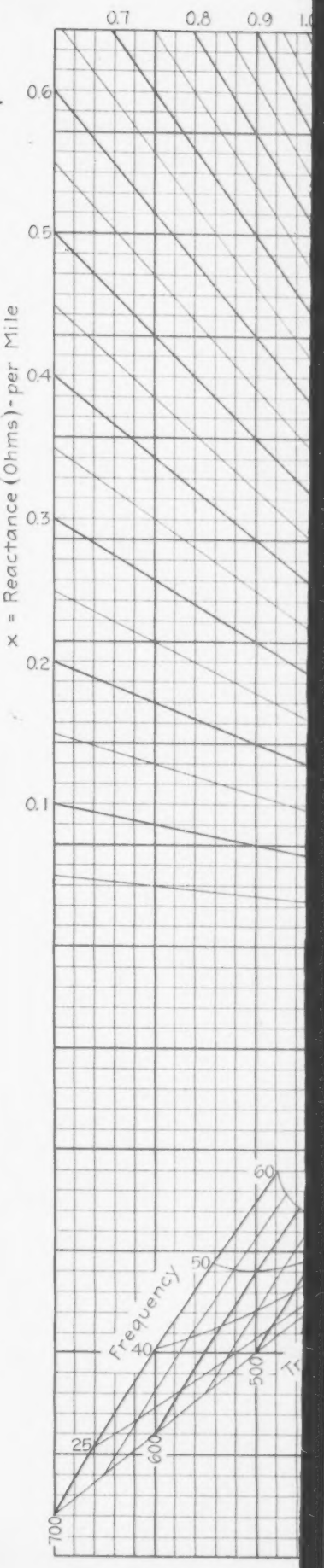


PRINCIPLE OF ELECTROMAGNETIC CONDENSER

into vibration of the same frequency. Owing to the interaction between these electrodynamic forces and the mass inertia of the vibrator, the zero position is passed at the instant when the current passes through zero, while the reversal of motion takes place at the instants when the current has crest values. Since on passing zero position the vibrator has maximum speed, the emf. induced in the stator winding is at these instants also at maximum.

Thus the condition of quadrature between the current causing the vibration and the emf. produced by this vibration is brought about. That the emf. must be a leading emf. will be obvious from the following consideration: After passing zero position in either sense, the current opposes the motion, and thus brings the magnet to rest at the end of its swing. The energy stored kinetically in the vibrator is during this period transferred electrodynamically to the alternating-current circuit. The circuit receives energy during the time that the current grows. On reversal, when the vibrator approaches its zero position, it must be accelerated by the dynamic force of the current. The vibrator takes energy from the circuit during the time that the current decreases from its crest value to zero. Thus the circuit receives energy while the current is growing, and must yield up energy while the current is waning.


rb = Resistance x Susceptance - per Mile (Ohms) (Micromhos)
Transmission Distance - Miles
Frequency
Constant a_2
Constant a_1
Constant A
CHART A
Constant = A = $a_1 + ja_2$
xb = Reactance (Ohms) x Susceptance (Micromhos) - per Mile



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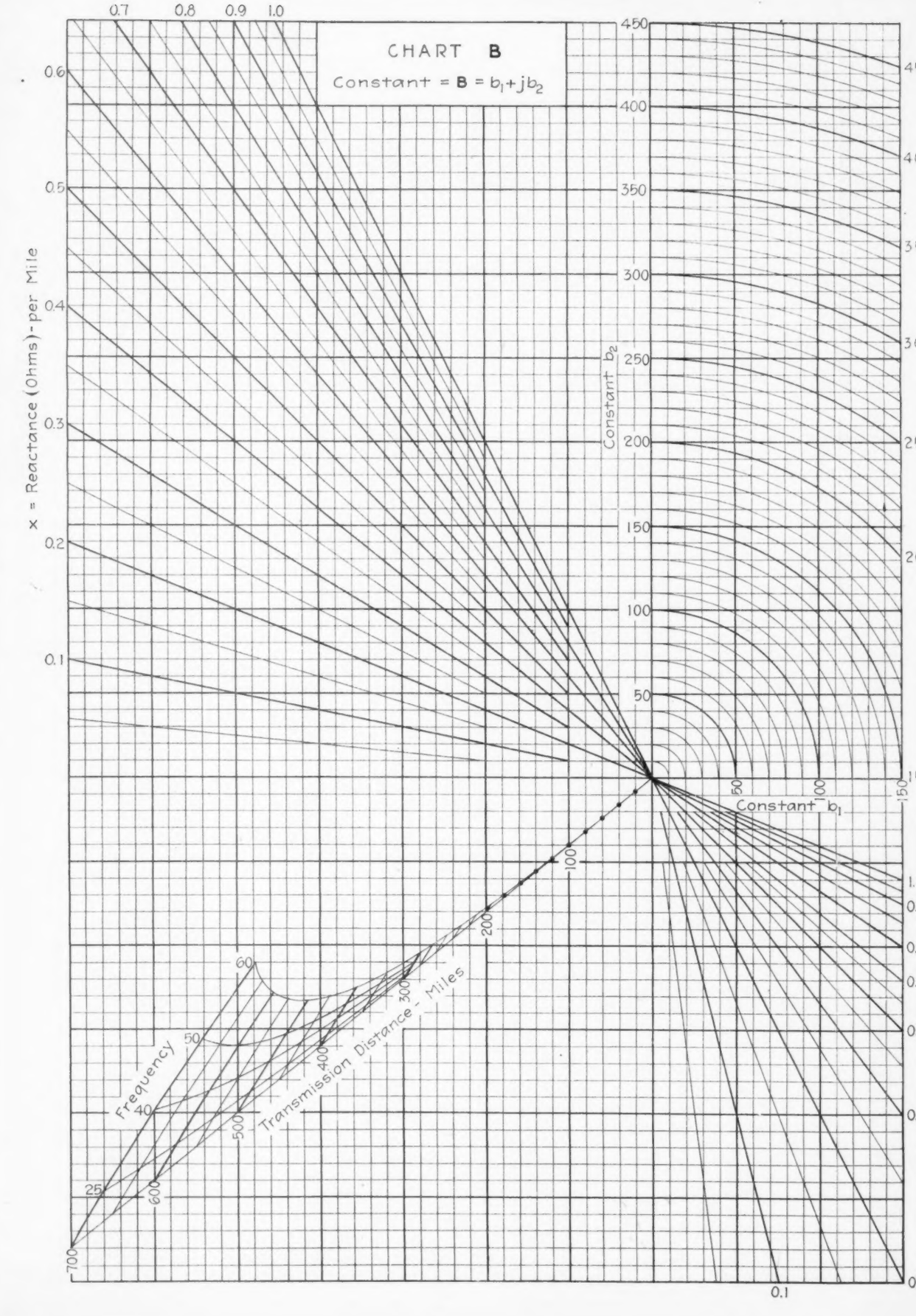

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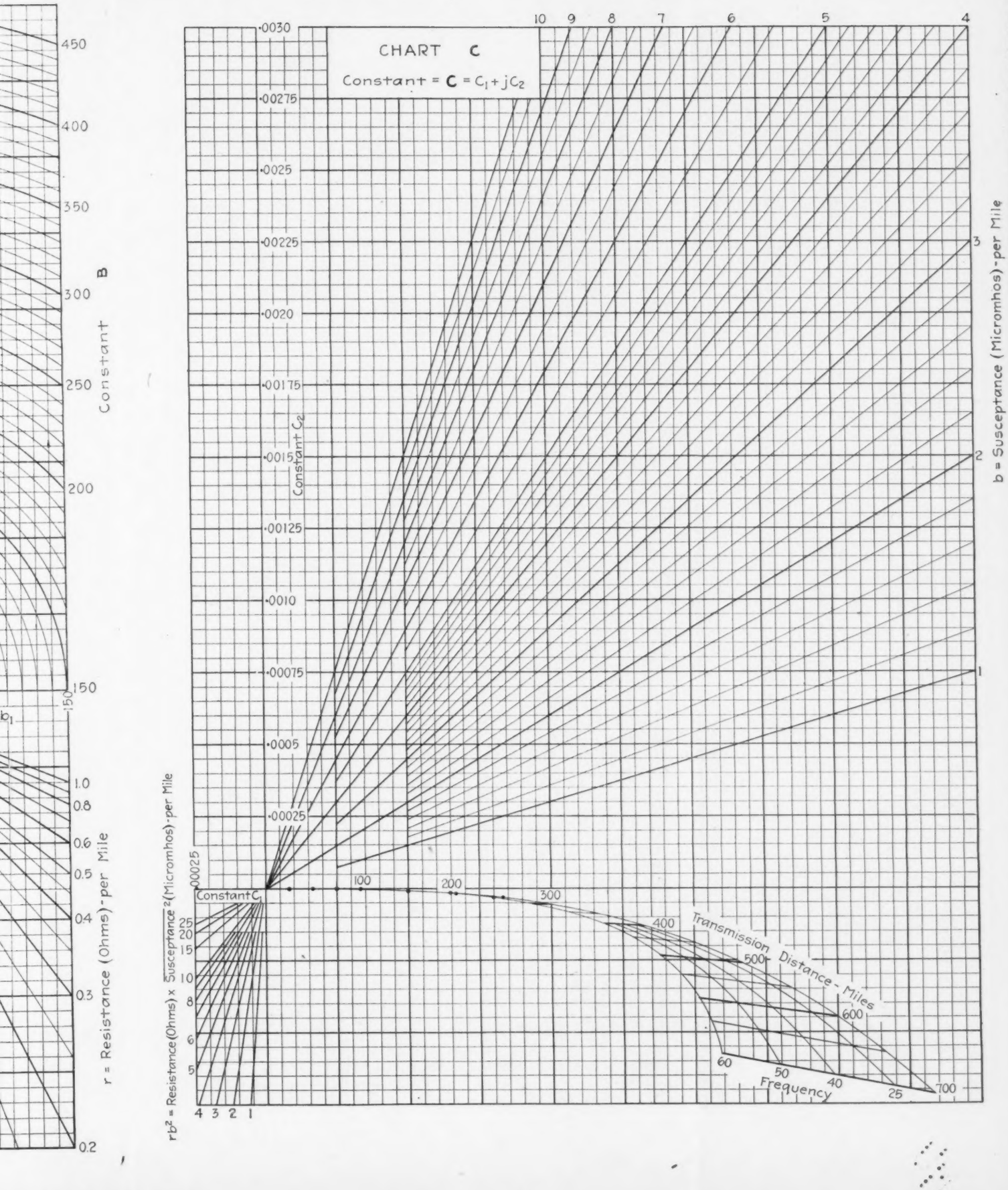


CHART C
Constant = C = C1 + jC2
Constant B
r = Resistance (Ohms) - per Mile
Constant C2
b = Susceptance (Micromhos) - per Mile
rb² = Resistance (Ohms) x Susceptance² (Micromhos) - per Mile
Constant C1
Transmission Distance - Miles
Frequency

rmination of Line Constants."

Graphical Determination of Line Constants

Three Charts Which Assist in the Evaluation of the Hyperbolic Transmission-Line Formula, Making Calculations Very Simple and Giving Highly Accurate Results—Numerical Example of Application

BY T. A. WILKINSON

Electrical Engineer Westinghouse, Church, Kerr & Company, Inc.

IN A RECENT issue of the ELECTRICAL WORLD* the writer showed that the hyperbolic formula giving the exact relation between the voltage and current at the two ends of a transmission line can be written in the following simple form:

Conditions at receiving end known:

$$E_l = E_0(a_1 + ja_2) + I_0(b_1 + jb_2),$$
$$I_l = I_0(a_1 + ja_2) + E_0(c_1 + jc_2).$$

Conditions at sending end known:

$$E_0 = E_l(a_1 + ja_2) - I_l(b_1 + jb_2),$$
$$I_0 = I_l(a_1 + ja_2) - E_l(c_1 + jc_2).$$

Where

E_l and I_l = voltage and current at the sending end.
E_0 and I_0 = voltage and current at the receiving end.
a_1, a_2, etc., = numerical constants for any given line, depending only on length, frequency and conductor conditions.

For determining the line constants a_1, a_2, etc., a simple formula was derived which, for convenience, is repeated below, in a slightly modified form:

Exponential formula:

$$1 - a_1 = xb(\tfrac{1}{2}l^{N_{a_1}}), \qquad a_2 = rb(\tfrac{1}{2}l^{N_{a_2}}),$$
$$b_1 = r(l^{N_{b_1}}), \qquad b_2 = x(l^{N_{b_2}}),$$
$$c_1 = -rb^2(\tfrac{1}{6}l^{N_{c_1}}), \qquad c_2 = b(l^{N_{c_2}}).$$

Where r, x and b are the resistance, reactance and susceptance, respectively, of the conductor per mile and N_{a_1}, N_{a_2}, etc., are variable exponents of the distance l, to be determined from an exponent chart for each particular case.

The above formula is capable of a very simple and direct graphical solution in which the only calculation required is the finding of the three products xb, rb and rb^2. The solution is made by means of Charts A, B and C accompanying the present article. The charts, in addition to giving the numerical value of the component constants, show the resultant vectors A, B and C in their correct geometrical position. The construction and use of the charts will be clear from Fig. 1, which represents in skeleton form Chart A, for the determination of vector A and its components a_1 and a_2.

Regarding the quantities in brackets in the above equations as coefficients of the unbracketed quantities and considering for the present only the constants $1 - a_1$ and a_2, the exponents N_{a_1} and N_{a_2} can be found for any assumed distance and frequency in the manner described for the exponent chart in the previous article, and the coefficients $\tfrac{1}{2}l^{N_{a_1}}$ and $\tfrac{1}{2}l^{N_{a_2}}$ can then be calculated.

DEVELOPMENT OF CHART A

In Fig. 1 let values of $\tfrac{1}{2}l^{N_{a_1}}$ be measured along OY and values of $\tfrac{1}{2}l^{N_{a_2}}$ along OX. For a given distance and frequency let P represent, by its co-ordinates OP_1 and OP_2, the values of the corresponding coefficients. Retaining the same frequency, the curve OPL will be the locus of P for other distances and for the same distance PQ will be the locus for other frequencies. By calculating the coefficients for a series of values of distance and frequency we can plot the intersecting curves of Chart A, from which the coefficients can then be interpolated for any assumed conditions.

By means of the diagonals through O the coefficients along OY and OX, corresponding to any position of P, can be multiplied by any assigned values of xb and rb, the products being the line constants $1 - a_1$ and a_2. These are read along OX' and OY', OT' being the constant $1 - a_1$ and OS' the constant a_2. If, now, the total length of OX' is made equal to 1, the complementary distance $T'X'$ automatically shows the value of a_1.

Thus, to find the line constants from the chart it is only necessary to find P for the assigned distance and frequency and follow the paths PTT' and PSS', using the proper values of xb and rb, the component constants a_1 and a_2 being read at T' and S'. Extending TT' and SS' to an intersection we get at V the point (a_1, a_2) with

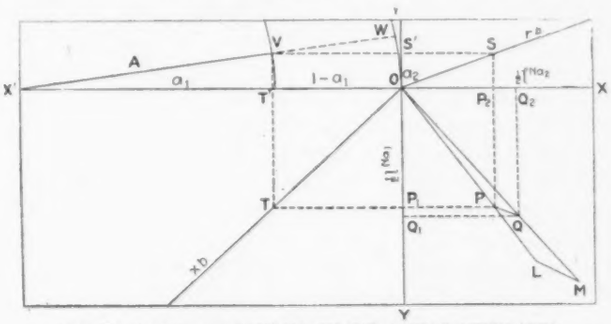


FIG. 1—BASIS ON WHICH CHART A WAS DEVELOPED

reference to X' as origin. $X'V$ is the vector A, its numerical value being read on the circular arcs drawn with X' as center. Values of r and x are in ohms and values of b in micromhos.

The vectors B and C and their components are found in a similar manner by means of Charts B and C, there being, however, no complementary values to consider, as in the case of a_1. On Chart C the negative values of c_1 will be noted. Owing to the small effect of c_1 the circular arcs are not drawn on Chart C.

The OLM diagram on each of the charts being based on the exponents of the standard circuit, as discussed in the previous article, the charts are subject, for other conductor conditions, to the same errors as the formula, which were analyzed in detail under the heading of "Accuracy of the Formula." As the maximum possible error is well within the limit of precision attainable in the practical use of the charts, it is entirely negligible.

Chart A gives, vectorially, the voltage relations of the line at no load, per volt of receiver line pressure. $OT' = 1 - a_1$ is the voltage consumed by the charging current flowing through the line reactance, and $T'V = a_2$ is the

*Feb. 2, 1918, p. 244.

voltage consumed through the line resistance. $X'V = A$ is the no-load voltage at the generator end of the line and VW is the voltage rise at the receiver end due to the capacity effect.

Chart B represents the impedance triangle of the line, in which b_1 corresponds to the total resistance, b_2 to the total reactance and B to the total impedance, these constants being simply the values of R, X and Z as modified by their distributed nature.

Chart C represents the charging current of the line. c_2 is the equivalent total capacity of the line. C is the total charging current per volt, of which a small component c_1 is in phase with the voltage. As c_1 is always very small in comparison with C, its numerical effect on the value of C is negligible, and for all numerical values both C and c_1 can be disregarded, c_2 giving the charging current to a high degree of accuracy.

Some Relations Shown by Charts

The charts show in a clear and interesting manner the effect on the line constants of the distributed nature of the resistance, inductance and capacity of the circuit. In Fig. 1 OL represents the values of the coefficients of $1 - a_1$ and a_2 for a given frequency, based on the exponential formula, in which the exponents of l vary with the distance. OM corresponds to the exponent 2 for all distances. The values of $1 - a_1$ and a_2, therefore, as determined from points along OM, will be $(xb/2)l^2$ and $(rb/2)l^2$ respectively.

The difference between the constants as determined from points P and Q is, therefore, that due to the difference in the exponents. It was shown in the previous article that the integral exponents give values of the constants corresponding to the assumption of lumped capacity and that the difference between the integral and true exponents represents the distributed effect. This effect is shown by the separation of points P and Q, in Fig. 1. The projections of PQ on OY and OX show at P_1Q_1 and P_2Q_2 the effect on each component separately. OP_1/OQ_1 and OP_2/OQ_2 are the ratios of the true value of $1 - a_1$ and a_2 by the hyperbolic formula to their values based on the assumption of lumped capacity.

It is interesting to note that b_1, corresponding to the ohmic resistance of the line, is the constant most affected by the distributed properties of the circuit. This constant reaches a maximum value at 60 cycles, for any value of r, at about 500 miles and decreases rapidly at greater distances. The ratio of b_1 to R at 500 miles is 0.67 and at 750 miles only 0.32. This brings out strikingly the fact that for a 60-cycle line the ohmic drop, with a given conductor, due to the load current, is a maximum at 500 miles, while in a line of quarter wave length it is less than one-third that of a short line of the same total resistance.

Numerical Example

The following example will illustrate the use of the charts in determining the line constants for a particular case:

Assume: Distance, 250 miles; frequency, 60 cycles; conductor, 300,000 circ. mil stranded copper; spacing, 15 ft.

From wire tables:

$r = 0.189$ ohm,
$x = 0.811$ ohm,
$b = 5.30$ micromhos.

Calculate:

$xb = 0.811 \times 5.30 = 4.30$,
$rb = 0.189 \times 5.30 = 1.00$,
$rb^2 = 0.189 \times 5.30^2 = 5.31$.

From charts:

$a_1 = 0.87$, $a_2 = 0.030$,
$b_1 = 43$, $b_2 = 193$,
$c_1 = -0.000013$, $c_2 = 0.0013$.

Conditions at the sending end when the above line is delivering 20,000 kw. at 110,000 volts, with power factor 0.95 lagging, are calculated as follows, for one phase, where P_0 and P_l are kilowatts at receiving and sending ends respectively:

$$E_0 = 110{,}000/\sqrt{3} = 63{,}500 \text{ volts.}$$
$$P_0 = 20{,}000/3 = 6667 \text{ kw.}$$
$$I_0 = 6667/(63.5 \times 0.95) = 110.5 \text{ amp.}$$
$$E_l = 63{,}500\,(0.87 + j0.030) + 110.5\,(0.95 - j0.31)\,(43 + j193)$$
$$= (55{,}200 + j1900) + (105 - j34.3)\,(43 + j193)$$
$$= (55{,}200 + j1900) + (11{,}140 + j18{,}790)$$
$$= (66{,}340 + j20{,}690)$$
$$= 69{,}500 \text{ volts.}$$
$$I_l = 110.5\,(0.95 - j0.31)\,(0.87 + j0.030) + 63{,}500\,(-0.000013 + j0.0013)$$
$$= (105 - j34.3)\,(0.87 + j0.030) + (-0.83 + j83)$$
$$= (92.4 - j26.7) + (-0.83 + j83)$$
$$= (91.6 + j56.3)$$
$$= 107.5 \text{ amp.}$$
$$P_l = 66.34 \times 91.6 + 20.69 \times 56.3$$
$$= 6076 + 1160$$
$$= 7236 \text{ kw.}$$

At no load:

$$E_l = (55{,}200 + j1900) = 55{,}230 \text{ volts.}$$
$$I_l = (-0.83 + j83) = 83 \text{ amp.}$$
$$P_l = 55.2 \times -0.83 + 1.9 \times 83$$
$$= -45.8 + 157.7 = 111.9 \text{ kw.}$$
$$\text{Regulation} = (55{,}230 - 69{,}500)/63{,}500 = -22.5\%.$$
$$\text{Efficiency} = 6667/7236 = 92.1\%.$$
$$\text{Power factor} = 7236/69.5 \times 107.5 = 0.969.$$

As the current phase angle, $\tan^{-1} 56.3/91.6$, is greater than the voltage phase angle, $\tan^{-1} 20.69/66.34$, the power factor is leading.

Data from a Coal-Mining Company Supplying Public Utilities

The Eastern Utilities Coal Company, controlled by the Eastern Power & Light Corporation, which is under the management of W. S. Barstow & Company, New York, supplies part of the coal required by subsidiary public utility companies. With regard to the present outlook it reports that the mines with 9-ft. (2.7-m.) seams have a capacity of 10,000 tons monthly, which can be readily increased. The following data are taken from the company's report of operations:

In June, 1917, with 102 cars supplied, its output was 5390 tons, which represented a percentage of capacity amounting to 53.9. This was increased to 6890 tons in July, or 68.9 per cent of capacity, with a total of 151 cars. This ratio was well maintained through the summer and fall. In December there came a slump to 3610 tons, 36.1 per cent of capacity, only eighty cars being supplied, and in January, 1918, there was a further decline to 2490 tons and fifty-two cars. In February the output rose to 3380 tons, with seventy cars.

Simple Method of Measuring Emfs. Accurately

Description of a Means That Will Be Found Applicable to Determining Temperatures with Thermocouples, Potential Drops Across Resistance Standards and Shunts, and Other Objects

BY F. WENNER, PAUL D. FOOTE AND E. E. WEIBEL

THERE are two general methods for measuring the emf. of a thermocouple, one requiring the use of a potentiometer and the other involving the use of a galvanometer or millivoltmeter. The potentiometric method affords the most accurate means of measuring the emf., but the galvanometer method is also used extensively because the instruments are direct-reading and require no preliminary adjustment. However, unless the galvanometer is of very high resistance compared with that of the thermocouple and lead wires, the latter in general being a quite variable factor, the instrument will not read correctly.

The object of the present note is to describe an instrument which combines several desirable features of each method, namely, cost of manufacture not much greater than that of a high-grade galvanometer, readings entirely independent of lead resistance, apparatus as accurate and probably more robust than the best galvanometers of high sensitivity. Two methods have been devised which differ from the one devised by Northrup* mainly in that the balance is indicated by zero change in the deflection of the millivoltmeter, on closing a key, rather than by a zero deflection. One of the methods also differs from Northrup's method in that the balance usually need not be made to so high an accuracy as that sought in the measurements.

The methods described here are not only applicable to the measurement of the emf. of thermocouples by means of a millivoltmeter (or galvanometer), but to the measurement of the emf. in circuits of any resistance not large in comparison with the resistance of the measuring instrument. Examples are the measurement by means of a millivoltmeter of the drop in potential across resistance standards (or shunts) carrying a current, when the resistance of the leads is high and unknown, and the measurement by means of a voltmeter of the open-circuit voltage of a battery or the voltage of a battery so located that connection can be made to it only through a line of fairly high resistance.

ONE METHOD OF MEASURING THERMOCOUPLE EMF.

For one of the methods the arrangement of the circuits is as shown in Fig. 1. With the rheostat or slide wire adjusted so that the millivoltmeter gives the same indication both with the key open and with the key closed there is a balance between the emf. of the thermocouple and the potential drop across the millivoltmeter. Consequently the drop in potential between the terminals of the thermocouple, which, with the key closed, is the reading of the millivoltmeter, is the same as its electromotive force.

Method of Balancing.—(1) The reading of the millivoltmeter or the position of its pointer is noted with the key closed; (2) the key is opened and this results in a change of the position of the pointer, depending on the lack of balance; (3) the contact on the slide wire is adjusted so as to bring the pointer back to or slightly past its first position. This brings about more nearly the condition for a balance. This process is, therefore, repeated until a balance is established to the accuracy required, which need not be high in case the resistance of the thermocouple is low in comparison with the resistance of the millivoltmeter.

In general the error resulting from a lack of balance is the same fraction of the lack of balance as the resistance of the theremocouple is of the resistance of the thermocouple and millivoltmeter. For example, if the resistance of the thermocouple is one-tenth the resistance of the millvoltmeter and the contact on the slide wire is adjusted so that, with the key open, the drop in potential across the millivoltmeter is 0.9 or 1.1 times the emf. of the thermocouple, the error in the reading, on closing the key, is only slightly in excess of 1 per cent. This for most industrial purposes is of little or no consequence. However, had there been no compensation—that is, had the electromotive force been measured directly with the millivoltmeter—the error would have been 9 per cent.

SECOND METHOD

For the other method the arrangement of the circuits is shown in Fig. 2. Here the millivoltmeter constitutes one arm, the slide wire R another arm, and the resistances P and Q the remaining two arms of a simple bridge. Since the bridge is balanced, the drop in potential across the slide wire R is the same as the reading of the millivoltmeter and the points G and G' of the bridge are at the same potential. Consequently, if the adjustments are such that there is no change in the reading of the millivoltmeter on closing the key, the emf. of the thermocouple is that indicated by the millivoltmeter multiplied by the ratio of the resistance between the sliding contact and G to the total resistance of the slide wire R. For example, if the millivoltmeter reading is 100 and the slide wire has 100 divisions, then each division between the sliding contact and G corresponds to a difference in potential of 1 millivolt.

Procedure in Making a Measurement.—First, with the key open, the contact on the slide wire S is adjusted so that the millivoltmeter reading corresponds to the full scale reading on the slide wire R; then the key is closed and the contact on the slide wire R is adjusted so as to make the millivoltmeter reading the same as before closing the key. The emf. or temperature is then read from the scale of the slide wire R.

*At a meeting of the American Physical Society held at Washington in April, 1915, Dr. Northrup described a potentiometer method in which a single millivoltmeter is made to serve both in place of a galvanometer and of a standard cell. With this method the millivoltmeter is connected, first, in series with the thermocouple for indicating (by a zero deflection) when there is a balance—that is, when the potential drop in the potentiometer is equal to the electromotive force of the thermocouple—and, secondly, across the potential terminals of the potentiometer for measuring the potential drop. The arrangement is such that the potential drop is not changed as a result of the current through the millivoltmeter. A similar method is used in an instrument manufactured by the Westinghouse Electric & Manufacturing Company (see *Electrical Review and Western Electrician*, Vol. 70, p. 98, 1916.)

For either method provision should be made for easily opening the battery circuit when the apparatus is not in use. This may be accomplished by making it possible to move the sliding contact past the end of the

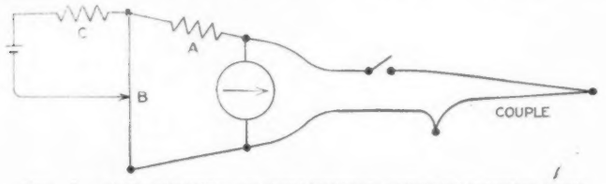


FIG. 1—ONE METHOD OF MEASURING THERMOCOUPLE EMF.

The resistances *A* and *C* and the slide wire *B* serve as means for adjusting this current so that the drop in potential in the millivoltmeter is equal to the electromotive force of the thermocouple. When this adjustment is made no current is drawn from the thermocouple on closing the key, consequently the resistance of the thermocouple does not affect the reading of the millivoltmeter.

slide wire *B* or slide wire *S*, or by means of a key, not shown in either diagram, in the battery circuit.

ACCURACY OBTAINABLE

While the resistance of the thermocouple does not affect the accuracy of the measurements when there is a balance, it does affect the accuracy with which the balance can be made. Still, with the resistance of the thermocouple in Fig. 1, or the thermocouple and slide wire *R* in Fig. 2, less than twice the resistance of the millivoltmeter, there should be little difficulty in making the balance with sufficient precision so that the electromotive force may be measured to an accuracy about the same as would be obtained if the thermocouple had no resistance and its emf. were measured directly with the millivoltmeter; that is, to the accuracy of the indications of the millivoltmeter.

In a particular case if the thermocouple gives an emf. of 15 millivolts at the maximum temperature at which it is to be used and has a resistance of less than 20 ohms, the millivoltmeter should have a range of 15 millivolts and 10 ohms is a satisfactory value for its resistance. In this case a single dry cell constitutes a very convenient source of current.

For the arrangement shown in Fig. 1 the millivoltmeter should be reliable at all points on its scale to an accuracy a little higher than that sought in the temperature measurements. Convenient values for the resistances are: A, 50 ohms; B, 5 ohms; C, 50 ohms. As the results obtained do not depend upon accuracy in the adjustments of the resistances the apparatus aside from the millivoltmeter and thermocouple may be of very simple construction.

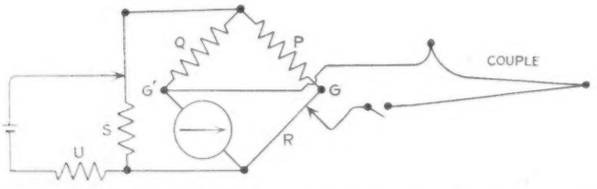


FIG. 2—ANOTHER METHOD OF MEASURING THERMOCOUPLE EMF.

The resistance *U* and the slide wire *S* serve as a means for adjusting the current through the bridge so that the drop in potential across the millivoltmeter has a desired value larger than the electromotive force of the thermocouple. When the contact on the slide wire *R* is adjusted so that there is no change in the reading of the millivoltmeter on closing the key no current flows in the thermocouple, consequently its emf. is equal to the drop in potential between the sliding contact and *G* (or *G'*) and may be read directly from the position of the sliding contact.

For the arrangement shown in Fig. 2 the millivoltmeter should be reliable at the reading used to an accuracy a little higher than that sought in the temperature measurements. Convenient values for the resistances are: *P*, 25 ohms; *Q*, 50 ohms; *R*, 5 ohms; *S*, 5.5 ohms (variable from 4 ohms to 5.5 ohms); *U*, 60 ohms. The resistances *S* and *U* need not be adjusted to any definite values, but *P*, *Q* and *R* should be so adjusted that the bridge will be balanced to an accuracy a little higher than that sought in the temperature measurements.

With either method, if all the thermocouples to be used with any one equipment give the same emf. for the same temperature, a condition well satisfied by the rare metal couples now obtainable, the apparatus may be calibrated so that the temperature is read directly from the scale of the millivoltmeter in one case and from the scale of the slide wire in the other case.

INCREASING TRANSFORMER CAPACITY BY CIRCULATING OIL

Installation of Oil-Circulating System at Cost of $700 Increased Permissible Loads on 200-Kva. and 450-Kva. Transformer Banks 60 per Cent

BY CLAUDE H. SHEPHERD

Electrical Engineer for the Lincoln Park Commissioners, Chicago

WHEN the main substation at Lincoln Park, Chicago, was built all multiple-circuit power was supplied by a bank of three 150-kva., 12,000/2300 volt, 60-cycle, single-phase, oil-filled, self-cooled, station-type transformers connected delta on the primary side and star on the secondary. These units were installed in an angle of the bus chamber as shown in the accompanying sketch. One spare transformer was provided but never used. Later a 200-kva., 12,000/2300-4000-volt, three-phase, oil-filled, self-cooled, station-type transformer was installed in the location shown and connected by means of double-throw disconnecting switches so it could be used in place of the 450-kva. bank. When this reserve equipment was put into service it was found that owing to the temperature of the bus chamber, which contains more than forty transformers, all of which are operated at night, the three-phase equipment became so hot as to be unsafe. The oil often attained a temperature of 75 deg. C.

To remedy this condition a ventilating system was installed and operated in such a way as to change the air about once in five minutes. This helped but did not eliminate the excessive heating of the transformers, and it was feared that the interior layers of insulation were beginning to carbonize. Sludge was rapidly forming in the oil so it was feared that unless drastic steps were taken immediately some of the three-phase equipment might be lost as the heat was actually unbearable in the immediate vicinity of either the three-phase bank or the single-phase transformer, the room temperature often attaining 140 deg. Fahr. (60 deg. C.).

Consequently oil-cooling apparatus was purchased and installed, practically no interruption of service being experienced, although the work was done under the most adverse conditions and in close proximity to both the 4000-volt and 12,000-volt buses.

By reference to the drawing it will be seen that the transformer oil is drawn by a direct-connected centrifugal pump directly from the transformer cases into an accumulator or settling tank and thence into the

pump, which discharges full volume into and through the cooling coils, the latter being immersed in constantly circulating water. From there the oil is discharged through a submerged outlet into the transformer. Two different suction systems were used. For the three-phase transformer the oil suction was taken through an already established connection at the bottom of the case, thus allowing automatic priming of the pump. In the case, however, of the three 150-kva., single-phase units it was found advisable to take the oil from the hottest part of the case, which was at the top next to the wall, the individual suctions being brought forward through the thermometer wells to regulator valves discharging into the main suction pipe or line. The discharge in each case was submerged and additional safety was assured by the use of fiber discharge nozzles.

TABLE I—HEAT TEST ON 200-KW. TRANSFORMER MADE SEPT. 11, 1917

Time, A.M.	Temperature of Transformer, Deg. C.	Kw.	Pump On	Pump Off	Cooling-Water Temperature, Deg. Fahr.
8:00	23	140	.....	8:00 a.m.	48
8:30	28	150	.....	.....	48
9:00	26	150	.....	.....	48
9:30	26	160	.....	.....	48
10:00	26	175	.....	.....	48
10:10	36	175	10:10 a.m.	.....	48
10:20	37	175	.....	.....	48
10:30	37	175	.....	.....	48
10:40	37	175	.....	.....	48
10:50	36	175	.....	.....	48
11:00	35	175	.....	.....	48
11:10	35	175	.....	.....	48
11:20	35	175	.....	.....	48
11:30	34	175	.....	.....	48
11:40	34	175	.....	.....	48
11:50	34	175	.....	.....	48
12 m.	33	170	.....	12:00 m.	48

It will be noted from the drawing that section valves are placed in the two main suction lines and that individual regulator valves have been placed in each individual suction and discharge line, and that a pump

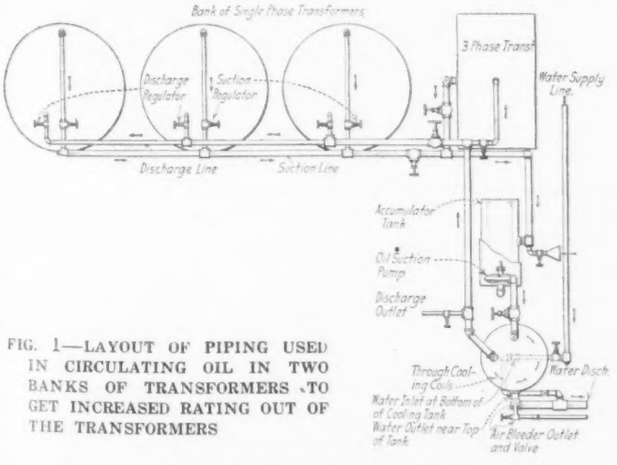


FIG. 1—LAYOUT OF PIPING USED IN CIRCULATING OIL IN TWO BANKS OF TRANSFORMERS TO GET INCREASED RATING OUT OF THE TRANSFORMERS

throttle was also installed, giving absolute control of the oil flow and allowing perfect adjustment under all conditions. A separate make-up funnel and valve were connected to the accumulator tank, and a T-connection and valve were placed in the discharge line, allowing oil to be either added to or taken away from the system at any time. With this arrangement it is obvious that the four transformer cases with oil at the proper level act as a reservoir system for each other, allowing levels to be adjusted or oil to be completely shifted from one case to another at any time. This plan gives assurance of great flexibility.

A thermometer is installed in the individual suction for each transformer and at the suction and discharge of the cooling coils, giving complete data on the temperatures. An oil gage is installed on each transformer to show the oil level and an air-bleeder valve is installed on the accumulator tank. The cooling water is supplied by the city system and is piped into the bottom of the coil tank. The overflow is installed near the top of the tank at such a level as to keep the coils always submerged. The supply connection is made through a T at the bottom of the tank, the continuation of the supply line being connected through a stopcock into the overflow line. Hence by closing the supply valve and opening the stopcock the tank may be quickly drained, a special air-bleeder line being provided to facilitate this operation. Three-phase energy is supplied to the pump motor from 220-volt taps on the secondary side of the main transformers. As the system is self-priming, no attention is paid to the pump during a shutdown as it will automatically come into operation again when the power supply is re-established.

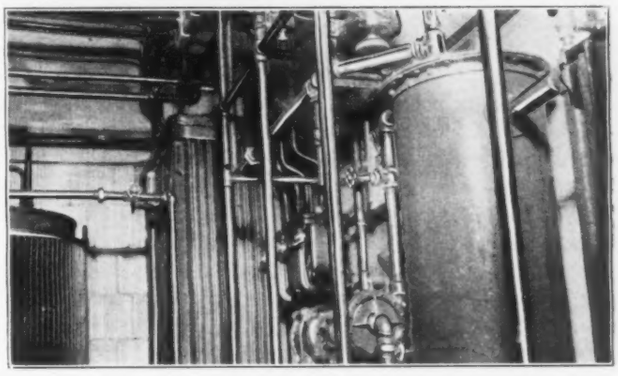


FIG. 2—THE 450-KVA. BANK IN THE FOREGROUND AND THE 200-KVA. BANK IN THE CORNER

TABLE II—COST OF OIL-COOLING INSTALLATION

LABOR		
Machinist, 79 hours at 55 cents	$43.45	
Steamfitter, 92 hours at 48 cents	44.16	
Helper, 79 hours at 38 and 40 cents	30.50	
Class A electrician, 99 hours at 75 cents	74.25	
		$192.36
Engineering and overhead		99.70
MATERIAL		
Fittings	$8.59	
One 14-in. by 30-in. galvanized-iron expansion tank	9.38	
One 18-in. by 45-in. galvanized-iron tank with cooling coils	71.50	
162 ft. 2-in. black pipe at 39 cents	6.42	
Six 0-110 deg. C. thermometers	57.38	
One ½-in. by 6-in. water glass	.10	
Miscellaneous screws, bolts, etc	9.31	
Electrical conduit fittings	17.91	
Piping and fittings for water supply	55.79	
Transil oil	.80	
24-ft. No. 8 fine stranded wire	.10	
One oil pump driven by 1700-r.p.m., three-phase, 3-hp., 220-volt, 60-cycle motor, 50 g.p.m., 30-ft. head	165.00	
Four transformer oil gages	6.28	
		408.55
Grand total		$700.61

three-phase transformer carried in actual operation a maximum day load of 325 kw. for about five hours per day with a maximum oil temperature of 41 deg. C. (105.8 deg. Fahr.), and a cooling water temperature of 44 deg. Fahr. (6.7 deg. C.). The cooling system, it is apparent, has increased the capacity of the 200-kva. transformer over 60 per cent. As this has been the maximum multiple circuit load so far, the 200-kva. transformer should have ample capacity when operated with the cooling system to "pull" the entire multiple-circuit load. In fact, since the installation of the cooling system it has never been necessary to operate the 450-kva. bank. Assuming the same relative percentage of core losses on both the 450-kva. bank and the 200-kva. transformers and allowing for the 1 kw. necessary to operate the cooling system, it is estimated that a net energy saving of $0.72 per day is obtained with the cooling system in operation, energy costing 0.0075 cent per kilowatt-hour. Assuming a percentage increase in the capacity of the 450-kva. bank on the basis of 60 per cent, it will be possible to pull a load of 720 kw. on this bank. The only doubtful point is whether or not the interior layers of insulation are beginning to carbonize. This question will be investigated during the winter, but judging from the quality of the oil now in the transformers no damage from this cause has appeared so far.

The test data in Table 1 show that in spite of the fact that the load was increased when the pump was started and remained at 175 kw. all night, the temperature of the circulating oil was steadily reduced from 37 deg. C. to 34 deg. C.

It will be noted that the temperature jumped from 26 deg. C. to 36 deg. C. when the pump was started, but this is due to the thermometer being in the suction riser. It indicates the riser temperature until the pump is started, thereafter the case temperature.

One change is necessary before the efficiency of the cooling system will be considered entirely satisfactory, and that is to substitute copper coils for iron pipe. The latter was used in place of copper because of the high initial cost of the copper. However, it has been found that for each passage of the oil through the cooler the temperature drop is from 2 deg. C. to 5 deg. C., whereas with copper coils it is expected that the temperature drop will be much greater. It is estimated that the investment in the present oil-cooling equipment earns about 37.3 per cent annually.

War-Time Methods of Bill Delivery

The Experience of Many Central Stations in Adjusting Themselves to Higher Postage Rates and Scarcity of Labor, Together with Comparative Statistics of Cost on the Different Methods

WITH the thought and energy of every central station concentrated as never before on measures of economy, a great many companies have turned a searching eye on their methods of delivering the monthly statement. The increase in the postal rates has brought a considerable additional cost in many cases, and the loss of men into the national service has generally reduced the organization available for carrying on routine work of this kind.

When the postage rate went up, of course, the idea of discontinuing the mailing of the monthly service bills and delivering them instead naturally suggested itself. There is more than the question of cost involved, however, for the mailing of a bill is generally conceded to be satisfactory proof of its delivery. Moreover, if delivered by hand, should this be done by meter readers, high-school boys, old men, girls or women? Or, if mailed, which is the better—post-card or regular bill inclosed in envelope? These questions are particularly pertinent right now and worth consideration by every central station.

Not long ago—but before the postal rates went up—the Cleveland Electric Illuminating Company made an analysis of the cost of its bill delivery, which includes 60,000 bills delivered by hand and 40,000 by mail, to find out how much could be saved by using a post-card bill. The figures were found to be as shown in the table on the next page.

With the 1-cent postage rate the post-card proved to be the cheaper method, but the doubling of this cost made the hand-delivery system far more economical. The system in Cleveland has been to place the delivered bill in the consumer's mail box, or if there is no box to hand it to a member of the family. Failing this, the distributer brings back the bill and it is mailed. For this delivery the Cleveland company first tried boys sixteen or eighteen years old, but did not find them satisfactory. It then employed elderly men of from fifty to sixty-five years and has practically eliminated all complaints.

In Sandusky, Ohio, however, the Sandusky Gas & Electric Company has had most satisfactory results from high-school boys, who both read the meters and deliver the bills. The boys receive 1 cent per meter read. Before the postal rate went up the company used government post cards, but since then it has devised a card of the same size, of which a six months' supply can be printed in advance. These are stamped and mailed to customers beyond the convenient reach of the delivery routes, but the bulk of them the boys deliver at a cost so far of approximately a half cent per bill. This the company finds is effecting a saving of $18 per 1000 customers per month on postage alone and is bringing additional economy by reducing the operating force to a minimum during the winter. Because of the limited number of hours that the students have available for this work, it is necessary to employ a much larger number than if the regular employees were handling it, but this has not proved an objection. About 9000 bills are delivered in Sandusky between the twentieth and the last of each month.

In Mobile, Ala., the company now delivers by hand at a cost of about 1½ cents per bill, a saving of about $37.50 a month since the postal increase. In Traverse

City, Mich., the company delivers to about 1400 consumers at a cost of 1 cent, and this also includes collecting about one-third of the accounts. In Pine Bluff, Ark., the company delivers 4500 bills, using the regular meter readers after the readings are completed. It requires from four to five days and costs in all, it is figured, from $10.50 to $12.50. In Kokomo, Ind., the company has also changed from mailing to delivery and is distributing 6000 bills by meter readers at a cost of $35. In Kingston, N. Y., the meter readers now deliver 5800 gas and electric bills, all except about 300 which are mailed to outlying territory, and the company finds the system quite as dependable as by mail. It saves approximately $50 every month. In Indianapolis the metermen of the Merchants' Heat & Light Company read meters every morning and deliver bills in the afternoon, and they have proved much more responsible than schoolboys, though boys were tried. The cost per bill now figures about 1 cent. In Denver the bills are mailed to the suburbs but delivered in the city by boys and young men on bicycles at a cost of one-third of a cent per bill.

COMPARISON OF COST OF PRESENT SYSTEM OF HANDLING 100,000 CONSUMERS' BILLS PER MONTH WITH PROPOSED SPECIAL CARD OR GOVERNMENT 1-CENT POST-CARD SYSTEM, AT CLEVELAND, OHIO.

Present system, printed bill in outlook envelope; 60,000 delivered by company distributers, 40,000 mailed with 2-cent stamps.

PRESENT SYSTEM:		
100,000 bills, at $1.50 per 1000	$150.00	
100,000 outlook envelopes, at $1.65 per 1000	165.00	
40,000 2-cent stamps in rolls	802.40	
Inclosing bills in envelopes—2 boys one month at $40 each	80.00	
Sealing 100,000 envelopes and affixing 40,000 stamps, one boy one month	45.00	
√Sorting 60,000 bills for delivery, one boy one month	40.00	
√Delivering 60,000 bills, five men at $70 per month	350.00	
Supervising delivery, half time of one man at $100	50.00	
Total		$1,682.40
PROPOSED SYSTEM:		
Special Cards, 1-Cent Post Stamp Affixed:		
100,000 cards, printed	$116.00	
Affixing stamps, one boy one month	45.00	
100,000, 1-cent stamps, in rolls	1,006.00	
Total		1,167.00
Amount saved by using special cards and affixing stamps		$515.40
Government 1-Cent Post Cards:		
100,000 cards	$1,000.00	
Printing	25.84	
Total	$1,025.84	
Additional saving with government cards		141.16
Amount saved by using government stamped cards		$656.56

Items checked √ indicate expense of delivering 60,000 bills per month. To find total delivery expense on 100,000 bills, add item No. 3, 40,000 2-cent stamps, $802.40.

In Wilkes-Barre, Pa., 19,500 bills—gas, electric and steam heat—are delivered by two men, who receive $65 per month, delivering continuously, which means a cost of about one-half cent per bill. These men collect when possible as they deliver. In Terre Haute, Ind., the company formerly had mailed all bills at a total cost of $125 monthly, but with the higher postal rate began delivering all bills within the city by one man, who is paid $45. The remaining postage cost for bills still mailed is also $45, so that in spite of higher postage the company is saving $35 monthly.

The consensus of opinion, therefore, judged from the experience of these and a large number of other cities heard from, would clearly recommend the delivery of bills within the centers of dense population. One Pennsylvania company, moreover, which operates through an extensive rural territory serving about 75,000 population, is delivering all bills in spite of distances, and claims a delivery cost of 0.92 cent per bill on a total of 7016 bills. This company lays much stress at the same time on the value of the collectors in maintaining good relations with the consumer, a point which is echoed by a number of other companies. Men are picked who do their work in a friendly spirit, and much good comes of it.

On the other hand, in many outlying towns in Indiana the Indiana Railways & Light Company began with this year to try the plan of not sending any bills at all to some 2000 customers, who are asked to call at the local offices to pay their bills, though delinquency notices are still mailed when necessary. In line with this, in Brattleboro, Vt.; in Franklin, Ind., and in Seymour, Ind., the local utilities have been furnishing many customers with cards on which to make their own meter readings. This method has met with considerable success. In Fort Madison, Iowa, the meter reader in certain residence districts carries with him bills already partly made out, on which he enters the reading, making out the bill and presenting it for collection at the one call. The company's other bills go out on post cards, and, in short, since the rates went up there has been a decided movement in the industry toward the post-card bill as offering an appropriate war-time economy.

FEW COMPANIES USING WOMEN

All in all, however, the trend is toward delivery, if not by meter reader, then by boys or old men. One New England central station has found a practical solution by making use of the services of the substitute postmen, who, though on waiting orders, are familiar with the town and have received instructions in delivering. Everywhere the possible expedient of utilizing women for delivering has been considered, but apparently it has not been adopted very largely. However, El Reno, Okla., reports the bill delivery in charge of two young women, who are taking care of it well and at a saving of $30 monthly on postage. At Binghamton, N. Y., girls are used to read meters and deliver bills.

Of course, the many cities where bills have always been mailed at the 2-cent rate are not affected by the postal increase. Buffalo and Wilmington, Del., state that they have no intention of changing, for they consider mailing less trouble and more sure. In Detroit, on the other hand, the company has been delivering bills by messenger for years at a cost much less than postage, the meter readers delivering the bills. In Providence, R. I., the method is optional with the consumer in most districts. He may have it by mail or messenger, as he prefers, and bills for suburban towns are delivered to the suburban post offices and mailed there under the local rate. There is plainly enough diversity, therefore, to suggest the advisability of every man looking well to his own conditions locally; but in the majority of cases delivery seems to be the preferred method.

Getting the Most Out of Turbo-Generators

Cleaning and Cooling Ventilating Air Not Only Increases the Rating and Reduces the Possibility of Burn-Out but Also Obviates Overhauling of Generator for Cleaning, with the Attending Disadvantages

BY L. H. PARKER AND J. J. PREBLE
Spray Engineering Company

WITH the advent of the modern horizontal-shaft steam-turbine generator, the ratio of the total kilowatt capacity to the cubical contents of power-plant engine rooms has increased at least two-fold or threefold. The necessity for adequate ventilation must, therefore, be recognized in order that a safe operating temperature for the electrical apparatus may be maintained and extreme engine-room temperatures avoided for the comfort of the attendants.

The enormous quantity of air required for ventilating large generators is perhaps better understood when the actual weights are considered. Assume, for example, a 20,000-kva. machine requiring 65,000 cu. ft. (1840 cu. m.) of air per minute. As this amount of air weighs about 2½ tons, the generator will handle an amount of air equal in weight to its own weight in from one-half to three-quarters of an hour.

While no one questions the necessity of supplying a generator with a sufficient amount of ventilating air, there are many who do not give the temperature and quality of the air sufficient consideration. The turbine manufacturers equip their machines with fans designed for handling the proper volume of air, but upon the consulting engineer, manager or superintendent of the plant falls the duty of seeing that adequate air-conditioning apparatus is installed, so that the machines will also receive cool and clean air. One effective device that can be used for this purpose is a properly designed water-spray type of air washer and cooler.

CLEANLINESS AND TEMPERATURE

Air in almost any locality contains considerable dust and dirt. In the vicinity of power plants it may be assumed that roughly one-hundred-millionth of the volume of the air consists of dust, dirt and other foreign particles. This would mean that with a machine handling 65,000 cu. ft. (1840 cu. m.) of air per minute, as mentioned heretofore, a total of 93,600,000 cu. ft. (2,650,000 cu. m.) would be handled in twenty-four hours. On this basis the amount of dirt passing through the machine in this period would be 0.936 cu. ft. (0.026 cu. m.), or 86 cu. ft. (2.4 cu. m.) in three months.

A certain proportion of this, because of air swirls and eddies, will necessarily be deposited in the air passages. Such deposits of dirt become a serious handicap to the ventilation. The air passages become partly clogged, causing a decrease in the quantity of air handled, and the cooling effect is greatly diminished owing to the fact that air cannot come in direct contact with the heat-radiating surfaces. Air taken from the inside of a power plant usually contains oily vapors, which make accumulations on the air passages rapid.

Unwashed air means dirty generators and excessive heating, which not only reduces the electrical efficiency but shortens the life of the insulation. Unless the machines are taken apart and cleaned periodically, grounds and even burn-outs are liable to occur. The cost of thoroughly cleaning a generator amounts to considerable, and under average conditions this has to be done about twice a year. The expense of dismantling and cleaning a 10,000-kw. unit would be about $500 for each operation, without taking into consideration the revenue lost owing to the machine being out of commission.

Since a generator which receives clean air is comparatively free from all such troubles, it is apparent that an air washer will practically eliminate any danger of a serious accident, with a resulting loss that might exceed many times the cost of the installation.

As all modern units are designed for a certain allowable maximum temperature in the armature and field windings, the temperature of a generator with a given load will be a fixed amount above the temperature of the ingoing ventilating air, which must be well below the critical temperature of the insulation. The cooler the air delivered to a generator, therefore, the greater will be its load-carrying capacity.

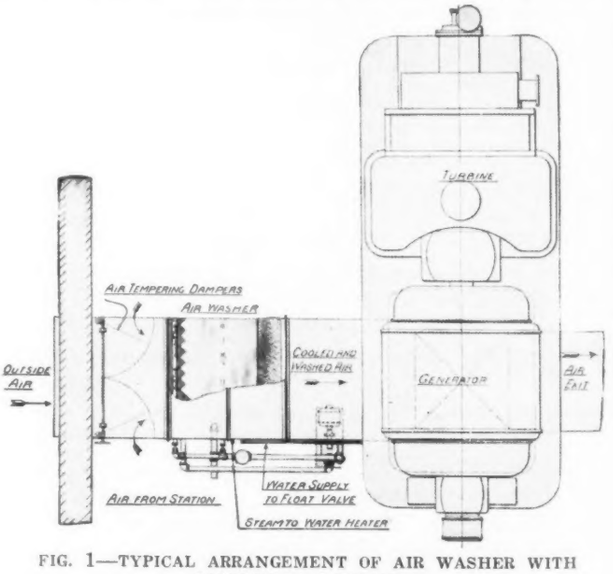


FIG. 1—TYPICAL ARRANGEMENT OF AIR WASHER WITH RESPECT TO GENERATOR

The permissible load on a turbo-alternator may, therefore, be expressed as a function of the temperature of the ingoing air. This relation* is given in the accompanying table based on representative 25-cycle and 60-cycle machines. The load is based on a fixed maximum temperature attained by any part of the windings. Since 25 deg. C. (77 deg. Fahr.) is a standard air temperature for electrical machinery, the load at this temperature is taken at 100 per cent.

The cooling which can be obtained by the use of air washing and cooling equipment varies with the make

*Curve given in *General Electric Review*, September, 1913

and type of washer. For use with electrical equipment a washer should be capable of reducing the temperature of the entering air at least 85 per cent of the initial wet-bulb depression. Table II shows the cooling effect with a washer of this class, using some of the higher temperatures given above, with different humidities.

It is possible, therefore, with this class of washer

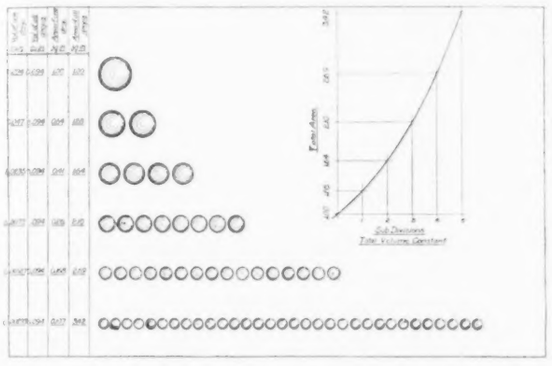


FIG. 2—HEAT-ABSORBING AND CLEANSING ABILITY OF ONE DROP MORE THAN TREBLED BY SUBDIVISION

to increase the safe load-carrying capacity within the above temperature ranges from a maximum of 22 per cent to a minimum of 3 per cent. With a washer that will cool to the wet-bulb temperature there is, of course, a further gain. Consequently, it is fair to assume that under average atmospheric conditions in the United States during the summer months the gain in load-carrying capacity would be at least 5 per cent.

WHEN WILL IT PAY TO INSTALL AIR WASHERS?

There are various ways of figuring whether an investment in air washers is actually justified. One way is considered in the following: Assume a typical modern steam-turbine power station containing three 10,000-kw. turbo-generator units. A plant of this size would cost about $3,000,000 if built to-day. During the

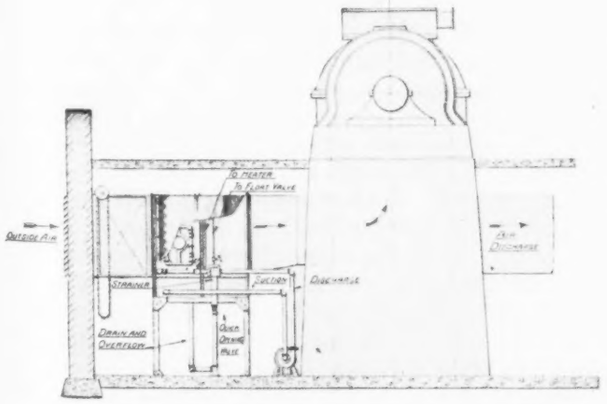


FIG. 3—SECTIONAL VIEW OF SAME INSTALLATION SHOWN IN FIG. 1

four summer months the permissible load on the generators would be reduced from full-load rating about 5 per cent on the average, on account of the warm atmospheric conditions. In most stations it is either necessary or desirable to operate at rated full load during this period.

In order to generate the full 30,000 kw. during the hot months it would, therefore, be necessary to do one of three things, (1) install air washers; (2) increase the size of the electrical end of the units, or (3) install a spare unit. For illustration it is sufficient to compare the first two.

Each of the 10,000-kw. machines would require a washer of 40,000-cu.-ft.-per-minute (1120 cu.-m.-per minute) capacity, and the total cost of the three washers would be about $7,500. The fixed charges on this investment, including interest, taxes, insurance, maintenance and depreciation (taken at 15 per cent), are $1,125 per annum. Adding to this $250, the operating cost of three 7½-hp. pump motors run one-third of the time, gives a total expense of $1,375 per year for the air-washer installation.

TABLE I—TURBO-ALTERNATOR LOAD AS A FUNCTION OF INGOING-AIR TEMPERATURE

Temperature of Ingoing Air		Load in Percentage of Load at 25 Deg. C.
Deg. C.	Deg. Fahr.	
5	41	123
10	50	118
15	59	112
20	68	106
25	77	100
30	86	92
35	95	82
40	104	70

On the other hand, if it be assumed that the size of the electrical-end equipment is increased 5 per cent (which, of course, is low) so that full load may be carried at all times, the extra cost would be about $30,000, figured at $20 per kilowatt. The fixed charges on this, at 15 per cent, are $4,500. Adding to this the cost of dismantling and cleansing the machines once per year at $500 per unit, the total yearly expense would be $6,500.

The net saving by installing air washers would therefore be $4,625 per annum for this 30,000-kw. station, or at the rate of about 15½ cents per kilowatt per annum. In other words, even on this conservative basis, the washers would pay for themselves in a little more than one and one-half years, without taking into account the benefits accruing from washed air, such as the insurance against accident and the losses incurred when the machines are out of commission for repairs and cleaning.

TABLE II—COOLING EFFECT WITH SPRAY-TYPE WASHER

Relative humidity, per cent....	40	50	60	70
Temperature of Entering Air, Deg. Fahr.	Temperature of Air Leaving Washer, Deg. Fahr. (85 per Cent Wet-Bulb Depression)			
68	56	59	60½	62½
77	63½	66	68½	71
86	71	74	77	79
95	78	81½	85	87½
104	86	89½	93	96

When about to purchase an air washing and cooling apparatus for this service, there are several items which, from an engineering standpoint, should not be overlooked. Merely to ask for a quotation on a washer of a certain capacity is comparable to asking for a quotation on a pump capable of handling a definite quantity of water, without regard to type, efficiency, speed or materials of construction.

Characteristics Which Should Be Required in Air Washers

In order to be efficient as regards both cleansing and cooling, and properly constructed, it is of prime importance that:

(1) The washer be provided with nozzles or other means of spraying the water, so that it will be finely atomized. The smaller the individual drops composing the spray, the greater will be the exposed surface for a given quantity of water. Therefore, both the cooling, due to evaporation, and the cleansing, due to the larger number of falling water particles, will be greatly increased.

(2) High pressures should be avoided, and the centrifugal pumps used for recirculating the spray water

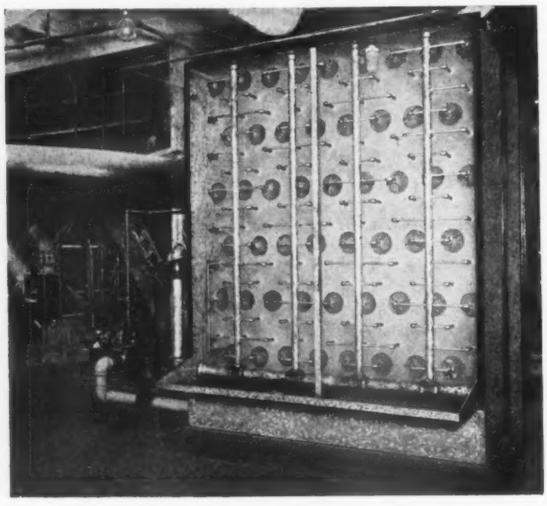


FIG. 4—ACTUAL INSTALLATION OF AIR WASHER USED IN CONNECTION WITH TURBO-GENERATOR

should be designed for high efficiency, so that the expenditure of power will not be excessive.

(3) The spray chamber should be completely filled with a dense mass of fine spray. Water curtains, or contrivances producing sheets of water, should be avoided, as, in order to pass, the air must necessarily punch holes in the sheet, which means that a considerable proportion of the air will not be properly cleaned or cooled.

(4) Means should be provided for completely eliminating all free moisture from the air before it leaves the washer. This should be accomplished without the use of heater coils.

(5) The materials used in the construction of the washer, as well as the workmanship, should assure long life. This requirement is met in one type of washer by using nozzles of bronze, screens of copper, casing and water box of heavy galvanized iron; eliminator plates, galvanized after fabrication; piping, galvanized; pump, bronze-fitted with inclosed impeller.

(6) The drop in air pressure through the washer should not be excessive. The allowable resistance measured at the inlet end of most generators is ½-in. (1.27-cm.) water gage, and the drop through the washer should therefore not exceed this, or the amount of air which can be handled will be diminished. The exact air requirements are usually given in the generator contract specifications or can be obtained from the manufacturers.

By way of further explanation, it may be added that the spray chamber should be of proper depth and the velocity of the air low enough to allow sufficient time for contact between the air and water spray. Obviously, the more efficient the nozzle, the higher the permissible air velocity, and consequently the more compact the air washer. Economy of space is of great importance in power plant work. Nozzles which produce a full conical spray of finely divided particles of water at medium operating pressures are well adapted for this class of work. Spray-atomizing screens are used advantageously on one of the well-known makes of washers in order to increase the atomization of the water.

Not long ago there were very few, if any, water-spray-type air-conditioning outfits used in connection with the ventilation of electrical machinery. To-day there are several hundred power plants in this country equipped with air washing and cooling apparatus, including practically all of the large well-known stations. The resulting gain in efficiency and capacity, the saving in maintenance and the longer life of the machines to which they are attached make the installation of air washers inevitable in all progressive and up-to-date power plants.

NEW ELECTRIC FURNACES FOR MAKING FERRO-ALLOYS

One Rated at 3000 Kw. Is Being Tested on San Francisco Bay, and Another One Is to Be Placed in Operation Very Soon

A 3000-kw. furnace is being tested out at the Pacific Electro-Metals Company plant, completed recently at Bay Point, near San Francisco. It is expected that another furnace of equal capacity will be added within a few weeks, so that together with the incidental load a total of about 7000 kw. will be utilized when the work is in full blast. Pending decision of a suit for lower rates which is being heard before the California Railroad Commission, the Great Western Power Company is supplying service on a rate amounting to $40 per horsepower-year. This is based on a guarantee of 90 per cent power factor and subject to readjustment on a kilavolt-ampere basis if the power factor falls lower. Energy is measured at 22,000 volts and the rate of $4.44½ per kilowatt-hour per month is charged on the basis of the average power consumption for the fifteen-minute period in which the demand is the maximum. The contract also restricts the conditions under which the load shall be used. There is to be a 10 per cent limit on the load between phases. The plant is supplied by a 22,000-volt, three-phase line about 14 miles (22.5 km.) long from the Clayton substation, which is supplied by the 100,000-volt line from the Big Bend generating plant, 125 miles (201 km.) distant.

ELECTRICITY FACILITATES COAL HANDLING AT CAMP

Description of Machinery That Not Only Saves $100 per Day, but Takes Care of Bigger Load with Less Help

Electrically operated machinery saves over $100 per day in coal handling at Camp Devens, Ayer, Mass., one of the cantonments of the National Army. During the recent severe weather the daily coal consumption of the cantonment was about 800 tons, and the problem of distributing the fuel through the camp is no small one. Camp Devens was designed to accommodate about 42,000 troops.

Coal is brought to the camp by rail and discharged upon the ground by gravity from a trestle of the Boston & Maine Railroad about 450 ft. (137 m.) long at the easterly side of the cantonment. A general view of this trestle and of three electric loading machines is shown in Fig. 1. A fourth machine, of the electric shovel type, is at present behind the trestle, on the other side of the storage pile, and is shown in Fig. 2. The coal-

FIG. 1—GENERAL VIEW OF MACHINES

handling contract within the cantonment is held by C. E. Hall & Sons, Inc., of Revere, Mass., who schedule the movement of fuel from the ground storage pile to the fourteen boiler plants in camp, using fifteen 5-ton and 6-ton gasoline motor trucks for delivery. The average round trip of each truck is 3 miles (4.8 km.), and about fourteen round trips are made daily per truck. Normally trucks are in service from 7 a. m. to 10 p. m.

A "close-up" view of one of the electric loading machines grouped in Fig. 1 and discharging into a 6-ton Hurlburt truck is reproduced in Fig. 3. These loaders were built by the Conant Machine Company, Concord Junction, Mass., and each has a capacity of about 30 tons per hour. Energy is supplied at 220 volts from a bank of transformers connected with the cantonment supply circuits, these being fed through a substation connected with a 66,000-volt line of the New England Power Company. Each loader is gear-driven by a 5-hp. Westinghouse three-phase induction motor mounted on a frame and housed in a sheet-iron box providing easy access for inspection. The motor speed is 1750 r.p.m., and a reduction to about 350 r.p.m. is obtained through the pinion and gear to the main driving shaft, from which a Griplock chain drive is provided to a wheel and shaft that provides the drive for the buckets. The buckets are 8 in. (20.3 cm.) deep, 8½ in. (21.6 cm.) wide and from 16 in. to 18 in. (40.6 cm. to 45.7 cm.) long, depending on the size of the machine. About twenty buckets are required per machine. The machines weigh from 2800 lb. to 2 tons (1270 kg. to 1840 kg.), according to size, and are easily moved about to

FIG. 2—ELECTRIC SHOVEL AT WORK

different portions of the coal pile. A flexible cable connects the motor in each machine with an appropriate terminal box or outlet on the trestle.

The electric shovel shown in Fig. 2 is of the Thew type and handles about one-fourth of the daily tonnage. It is designed for revolving service and is self-propelled. Energy is supplied through a flexible cable, the machine being operated by a 20-hp. Westinghouse induction motor. A 6 ton truck can be loaded in about five minutes with this equipment. The best day's work of the four electrically driven machines at the Camp Devens coal-reclaiming yard to date is 1056 tons. Formerly 150 men were required for this work and the maximum tonnage handled in one day was 750 tons by hand, and with motor truck distribution. At present three men are used on the shovel, one being an operator, who receives

FIG. 3—"CLOSE-UP" VIEW OF LOADING MACHINE

91 cents per hour for forty-four hours per week and double rates for overtime. The loaders require one, two or three men each for the most rapid feeding, and the whole force now is composed of only about twenty men. The capacity of the ground storage is about 50,000 tons.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

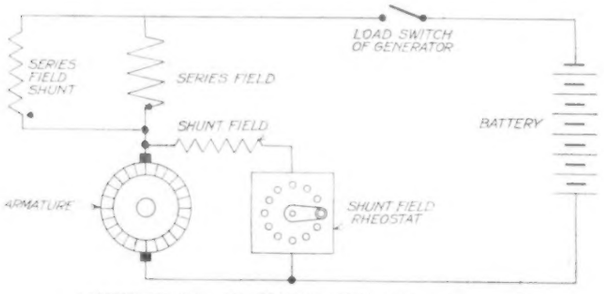
LOCATING TROUBLE IN MOTOR-GENERATOR SET

Generator Was Being Motored Owing to the Clamp of Two Bottom Series-Field Coil Interconnections Working Loose

BY E. C. PARHAM

That all battery-charging circuits should include a reverse-current circuit breaker to prevent the cells from motoring the generator should the generator voltage fall below that of the cells is shown by the following incident: A motor-generator set after being connected to some batteries all night appeared to be unable to charge the batteries. The set was found to be running at a reduced speed with circuit breaker open. The accompanying diagram indicates the connections.

The set was shut down by pulling the knife switch and the generator was carefully inspected. The series field-coil interconnections were of the clamp type and the clamp of the two bottom coils had worked off, there-



CONNECTIONS OF MOTOR-GENERATOR CIRCUIT

by opening the series winding and making it necessary for the series-field shunt to carry the total current. Had there been no series-field shunt, the loosening of the clamp would have opened the circuit between the generator and the battery and there could have been no motoring action.

As it was, however, the cutting out of the series winding lowered the voltage of the generator to a value that was below that of the battery and the shunt held intact the circuit that was necessary for the motoring. Up to the time of the opening of the motor breaker the driving motor and the battery had been operating the set in the same direction.

Emergency Temporary Repair for Plain Grate

Recently in a small Middle West power house where it was not possible to secure plain grates owing to delays in deliveries, etc., temporary grates were constructed of 2-in. (5-cm.) and 3-in. (7.5-cm.) pipe sawed to the proper length. This makeshift repair tided the plant over the period of railroad congestion and maintained steam-heating and electric service until the repair parts which were in transit arrived.

A MOTOR-DATA SHEET FOR INDUSTRIAL PLANTS

All the Important Data Concerning the Installation of Each Motor Are Included in This Comprehensive Record

To avoid the usual lack of complete data bearing upon motor applications in industrial plants, a Massachusetts factory uses the form reproduced herewith. On a sheet 8½ in. by 10¾ in. (21.5 cm. by 27.3 cm.) in size all the more essential data are listed, including the factory section, department and floor on which the

MOTOR

For .....Date.....191

Dept.....Bldg.....Sect.....Floor.....Size H.P.....

Voltage - 230 D. C.....Duplicate of Similar to Drive on Mach. No.....Shunt / Compound Wound / Series

Constant / Variable Speed Normal Speed.....By Armature..... / By Field.....

Direct / Clutch Connected. Back Geared.....Ratio.....Reversible.....

Pulley Diam.....Face.....Teeth in Gear.....Sliding Rail Base.....

Arranged for Floor Mounting / Ceiling Suspension Enclosing Covers / Mesh Enclosed

Make Recommended by Drafting Dept.....Type.....

Catalogue.....Page.....

Plain heavy Duty Starter with Renewable Segments
Armature Controller with Renewable Segments - Fan Duty.
Compound Controlled With Renewable Segments - Machine Duty
Starting Resistance and Field Control with Renewable Segments.
Overload Release
Printing Press Type
Self Starter - Lock and Key

Panel with Knife Switch and Fuses / Circuit Breaker

Reverse Switch.....Dynamic Brake.....

.....Single / .....Double Push Button Stations Number Steps Armature / Field.....

Ship to.....

.....

Wanted.....Appropriation received.....

Ordered.....From.....

Remarks:

Our Number.....

COMBINED MOTOR ORDER AND DATA SHEET FOR USE IN INDUSTRIAL PLANT

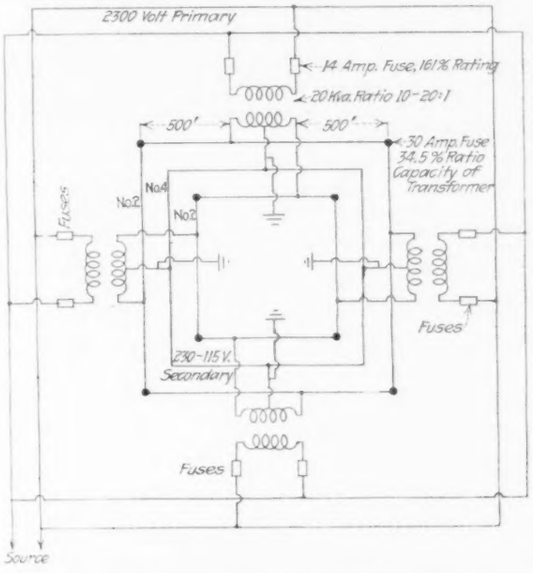
motor is going, speed, pulley and suspension or mounting details, type of covers, make recommended by drafting department, type of controller and shipping directions.

On the original order it has not been customary to fill in more than the necessary information for the motor maker and control manufacturer, but the complete information desired by the plant is kept on the filed sheet, which is convenient in its provision for all the important facts.

ECONOMICAL PLAN OF FUSING INTERCONNECTED SECONDARIES

Placing Fuse at Neutral Point Between Transformers and Choosing Fuse Rated at 30 per Cent of Transformer Is Recommended

In discussing the advisability of fusing interconnected transformer secondaries on a single-phase distribution system, M. E. Grah of the Toledo (Ohio) Railways & Light Company expressed the opinion before a meeting of the distribution committee of the Ohio Electric Light Association that fuses should be



BANK OF FOUR TRANSFORMERS WITH INTERCONNECTED SECONDARIES FUSED AT NEUTRAL POINTS

used. If the secondary is not fused, said he, the primary fuses of all transformers will probably blow in case any transformer fails. When this happens it will be impossible to energize the bank again until the secondaries are sectionalized. Moreover, if a primary fuse is blown and the secondary network is alive from other transformers, the transformer which is in trouble is "alive" and should not be inspected until its secondary has been disconnected. These have been the great objections to banking transformers.

Having decided to fuse the transformer secondaries, the next question to settle is the location of the secondary fuses. If the secondary fuses are placed at the transformers, some saving in time is made in getting at the transformer for inspection in case of trouble. It is Mr. Grah's opinion, however, that this method of fusing does not obtain the results desired from fusing and requires the use of fuses of such size as to be too costly for the benefits derived. A better arrangement can be secured by fusing the primary of the transformer for about 150 per cent of its rating and placing a fuse rated at about 30 per cent of the rating of one transformer at the neutral point between the transformers of the bank.

For an example consider the layout shown in the accompanying diagram. Here are shown four 20-kva., 2300/220/110-volt transformers with interconnected secondaries. In the primary 14-amp. fuses are used as the standard size, giving nearly 150 per cent of the transformer rating. In reality the 14-amp. fuse gives 161 per cent of rating. This permits the 80-kva. transformer bank to deliver a total maximum rating of 128.8 kva., or 32.2 kva. per 20-kva. unit, or 140 amp. at 230 volts. The full-load rating of each transformer is 87 amp. at 230 volts, and with the load divided equally at the transformer this allows 43.5 amp. each way from the transformer. By assuming the transformers to be 1000 ft. (304.8 m.) apart and that the neutral point is just half way between them, it can be decided to install these fuses in the outside wires rated at 30 per cent of the rated capacity of the transformers. This will permit an interchange between transformers of 30 amp. or 6.9 kva. Such an interchange may appear small, but in case of failure of one of the transformers this fuse is designed to blow before permitting either of the adjoining units to become overloaded more than 134 per cent.

To prevent trouble from accidental grounds, Mr. Grah recommends grounding the neutral of the secondary on poles adjacent to transformer poles if primary lightning arresters are installed on transformer poles, or on the transformer poles themselves, if possible.

EMERGENCY SWITCHING AND COMMUNICATING SCHEME

Used to Advantage in the Repair or Rebuilding of Transmission Lines Which Cannot Be Worked on While Alive

A switching and communication scheme which may be used to advantage during line repairs or rebuilding is illustrated herewith. It is particularly applicable to the reinsulating of loop lines of from 11 kv. to 22 kv. which cannot be worked on while "alive" and which have such characteristics that, while one arm of the loop is adequate to carrying the day load, both branches must be placed in operation each evening.

As will be seen from the diagram, a small transformer with indicating lamps is placed just inside of each of the switches which cut out the section to be worked on. Two lamps are used to insure against failure, and the transformers are not fused, to eliminate incorrect signals due to a blown fuse. In addition, a branch line switch is installed at each point. Two terminals of this switch are used to short-circuit and ground one phase of the line; the other cuts a telephone into the circuit.

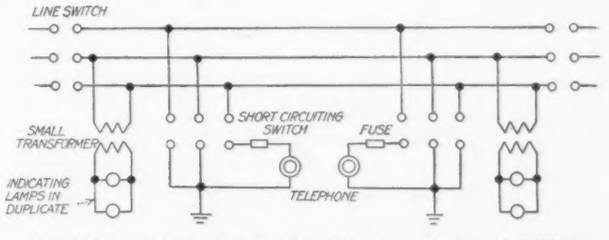


DIAGRAM OF CONNECTIONS FOR COMMUNICATING SCHEME

In the morning the foreman of the repair crew proceeds to one switch and a patrolman or the foreman of a second crew to the other. Each opens his line switch on arrival, and when the second has been opened the lamps at both points go out. Each then throws in the short-circuiting switch and after waiting two minutes they communicate by telephone and the fore-

man receives a definite report that the other switch is open. At night the procedure is reversed; at an appointed time the men communicate by telephone and each reports all men clear. They then hang up, open the short-circuiting switches, wait two minutes and then close the line switches. Even should an incorrect lamp signal be given by the coincidence of failure of energy on the line while one man is waiting in the morning, no accident beyond the shutting down of the line will occur, since the line is not worked on unless short-circuited and grounded. This system is obviously unnecessary where commercial telephones are available near each switch point.

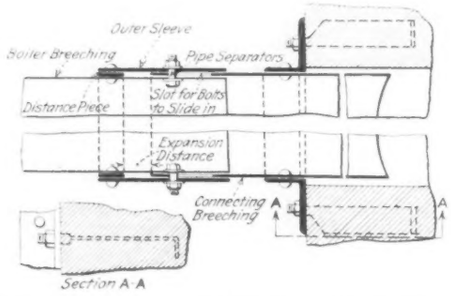
EXPANSION JOINT USED IN SMOKE BREECHING

Reasons Why This Type of Joint Is Best in a Long Breeching Which Is Designed to Serve a Number of Boilers

BY T. W. REYNOLDS

Without some provision for expansion and contraction, the breeching will in course of time leak at joints and uptakes with detriment to the proper draft. More particularly is this true of its connection to the chimney opening, at which point the breeching is riveted to angles which are in turn secured by anchor bolts to the brickwork of the chimney. Intermittent operation, forcing of boilers and the extremes of temperature changes will soon force an opening at this point and draw the anchor bolts from their fastenings. Therefore a long breeching serving a number of boilers should have an expansion joint next to the brick chimney, particularly when the connecting portion to the chimney is exposed to the weather and not covered.

In the construction illustrated the breeching, usually of No. 10 gage, is terminated at a point near the chimney and provided at this end with an outer sleeve of ¼-in. (0.6-cm.) iron, 10½ in. (26.7 cm.) in length. At the boiler end of the sleeve a continuous-distance piece of 2-in. by 5/16-in. (5-cm. by 0.7-cm.) iron is riveted on 4-in. (10-cm.) centers to and between the breeching and sleeve. This forms a space entirely around the breeching, 5/16 in. by 8½ in. (0.7 cm. by 22 cm.) in length, into which space is fitted a breeching of ¼-in. (0.6-cm.) thickness connected at its other end through



DETAILS OF JOINT FOR EXPANSION AND CONTRACTION

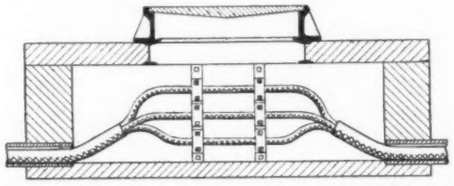
the chimney opening. The boiler breeching, being free to move, slides as a hollow piston inside of this latter breeching for a maximum distance of 2½ in. (6.5 cm.), this being the distance fixed by the construction as shown herewith.

The connecting breeching and outer sleeve are secured together by bolts with washers under the head and with pipe separators as distance pieces around the bolts. The bolts slide in the slots cut out in the connecting breeching, their movement being equal to and dependent upon that of the boiler breeching.

CABLE RACKS DESIGNED FOR UNDERGROUND SERVICE HOLES

Eliminates the Use of Junction Boxes—Cables Are Fanned Out and Passed Through Insulators—Cost Saving

Hand-holes have been provided between manholes on the underground system of the Knoxville (Tenn.) Railway & Light Company to facilitate service taps and inspection. Ordinarily expensive junction boxes are



RACK WHICH ELIMINATES USE OF JUNCTION BOX

provided in all hand-holes, but in the Knoxville system these junction boxes are eliminated, the cables being fanned out and passed through insulators, as shown in the accompanying diagram. All service connections are made by soldering directly on to the cables and taping the joints. This construction reduced the cost one-eighth and has proved thoroughly satisfactory in operation.

INTERESTING POLE-SETTING RECORD OF WESTERN COMPANY

1503 Poles Set Over 35.5 Miles of Line and Three Villages at an Average Expense of 26.5 Cents per Pole

The Dakota Engineering & Construction Company, which is at present engaged in the erection of a high-tension transmission line from Valley City, N. D., to supply a group of small outlying villages, claims that during the last season its men set seven 60-ft. (18.3-m.), thirty 40-ft. (12.2-m.), 124 35-ft. (10.7-m.), 1222 30-ft. (9.1-m.) and 120 25-ft. (7.6-m.) creosoted Western cedar poles, a total of 1503 pieces, over 35½ miles (57 km.) of line and three villages, at a total cost of $398.85, an average of 26½ cents per pole. The crew consisted of six men including the foreman. The foreman received $4.50 per day and the laborers $3. On the high-tension lines in the country it was common for this crew to set from eighty-five to ninety 30-ft. poles per day, an average in spite of the high wages of only 21 2/3 to 23 cents each.

The poles were set, lined and tamped, having been placed near the holes previously. All 40-ft. (12.2-m.) poles and lighter ones were set with four pikes, larger poles by means of block and tackle. In no case were more than six men used on the pole-setting crew. It might be mentioned, in addition to the above, that each pole carried a 25-lb. (11.3-kg.) iron wishbone arm when raised.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

RATES FOR THAWING FROZEN WATER PIPES

New York Company Has Derived a Revenue of $895 During the Past Winter from This Work

H. K. Stein, superintendent of the Genesee Light & Power Company of Batavia, N. Y., commenting upon the article on rates for thawing frozen water pipes in the Feb. 16 issue of the ELECTRICAL WORLD, page 363, writes as follows:

"The Genesee Light & Power Company has been thawing pipes by electricity for some time past and has charged for its service on a different basis from that noted in the article concerning the practice of the company at Binghamton, N. Y. The Genesee Light & Power Company makes a charge of $5 for an 0.75-in. (1.9-cm.) pipe and an additional charge of $5 for each 0.25-in. (0.63-cm.) increase in size. Up to the present date the company has thawed 152 water services varying in size from 0.75 in. (1.9 cm.) to 3 in. (7.6 cm.), with a resultant revenue of $895. This shows an average revenue per service thawed of $5.88 per service."

[See also ELECTRICAL WORLD for March 2, page 467.—EDS.]

ELECTRIC RANGE BUSINESS GROWING IN SMALL CITIES

An Analysis of the Range Situation Shows the Smaller Towns to Be Taking Up This Load Actively with Good Success

While in the large cities central stations may not expect to push ranges this year, they will in the great majority of cases continue to sell them. The usual amount of publicity will probably not be given to the range business, but sales will be made quietly as a matter of routine. This, in fact, is going on at the present time. But in the small towns and cities there is a different outlook on the range business.

For purposes of analysis these smaller communities can be placed in two classes—first, those owned and operated by holding companies; second, those owned and operated by local capital. It seems probable that there will be less activity in the former group than in the latter. This is a natural consequence of the present financial situation, in which borrowing capital is a difficult process. The companies owned locally do not encounter so much of this trouble as others because their sources of capital have not yet been subject to such severe drains as have the central markets. Moreover, some locally owned companies have in general been less forward in making rates for electric cooking and in establishing twenty-four-hour service than other companies. The backward companies, seeing an opportunity on account of the high cost of domestic fuel to get range business easily, are making cooking rates. It is true that in some cases they are looking at the revenue from cooking as an additional source that need not necessarily bear so much of the fixed cost as business already existing. But nevertheless the rates are being inaugurated, and these newly opened towns are providing this virgin territory for the range salesman to work. If it is found that time payments are essential to the success of any of these small-town campaigns, it is felt that there will be little difficulty in getting the money to carry the accounts. The operations of the Morris plan banks have opened the eyes of nearly every small-town banker to the possibilities of making money out of handling accounts of this nature.

Tangible evidence of the correctness of this analysis has been secured by the Hughes division of the Edison Electric Appliance Company. A circular letter was sent to a large mailing list of central stations, and inclosed therewith were a small envelope stuffer on ranges and a return post-card order blank for ordering either ranges or advertising helps. It was expected that there would hardly be any range orders, but it was thought that there would be calls for advertising helps from the cards. At the end of eight days after the letter had gone out the company had replies from eighteen companies in different states, and the replies included actual orders for $985 worth of ranges. But the most interesting fact about the results of the letter is that the replies came mostly from communities that had never before been known as range markets. As indicating the character of the communities to which the letter and the range business appealed, a list of some of the towns is given: Zionsville, Ind.; Great Barrington, Mass.; Kalispell, Mont.; Albany, Ga.; Elma, Iowa; Deansboro, N. Y.; Froid, Mont.; Williamsburg, Ky.; Bloomville, Ohio; Earling, Iowa; Liberty, Mo.; Intercourse, Pa.; Oak, Neb.; Norton, Kan.; Clinton, N. C.; Salt Lake City, Utah; St. George, Utah; Armstrong, Iowa; Clearwater, Fla.; Boonville, Ind.; Portland, Me.; Portsmouth, Ohio; Lamoni, Iowa; Gillespie, Ill.; Midland, Tex.; Huntington, Mass.

THE DIFFICULTY IN HANDLING APPLIANCE PAYMENTS OVERCOME

A Special Colored Coupon Is Attached to the Monthly Bills of Customers Having an Open Account for Appliances, Thus Saving Work

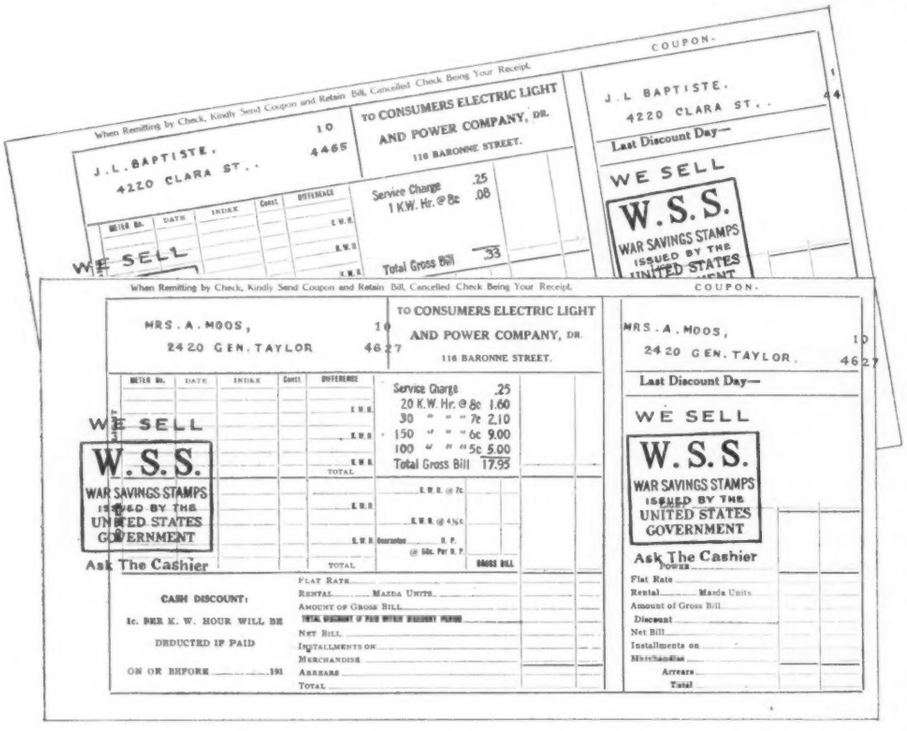
Trouble has been found by cashiers of utility companies in taking care of payments on account for special campaigns where these payments were included with the regular bill for meter service. In order to eliminate this difficulty, the Rochester (N. Y.) Railway & Light Company, in one of its special appliance campaigns recently, issued a special colored coupon which is attached to the regular monthly bill of any person who bought one of the appliances in that campaign. When the cus-

tomer pays his bill for service and also for the appliance the cashier stamps both bills paid in one operation, tears off the special colored slip and places it on a separate file.

RUBBER STAMPS SAVE EXPENSE IN BILLING

Company with Sliding-Scale Rate Does Billing Now in One-third Time Required for Industrial Calculations

The Consumers' Electric Light & Power Company of New Orleans has just introduced a system of rubber stamps to save some of the clerical work entailed in making out its several thousand monthly bills. Under the company's rate lighting service is figured on a sliding scale and a great deal of calculating is required in figuring the bill totals each month. To make out a bill for 300 kw.-hr., for instance, it has been necessary to list five amounts and the total, including, first, the service charge of 25 cents; second, the first 20 kw.-hr. at 8 cents; then the next 30 kw.-hr. at 7 cents; then the next 150 kw.-hr. at 6 cents, and the final 100 kw.-hr. at 5 cents. These extensions must then be totaled.


When Remitting by Check, Kindly Send Coupon and Retain Bill, Cancelled Check Being Your Receipt.
COUPON.
J. L. BAPTISTE, 4220 CLARA ST.
TO CONSUMERS ELECTRIC LIGHT AND POWER COMPANY, DR.
116 BARONNE STREET.
Service Charge .25
1 KW. Hr. @ 8c .08
Total Gross Bill .33
Last Discount Day—
WE SELL
W.S.S.
WAR SAVINGS STAMPS ISSUED BY THE UNITED STATES GOVERNMENT
Ask The Cashier
MRS. A. MOOS, 2420 GEN. TAYLOR
4627
Service Charge .25
20 K.W. Hr. @ 8c 1.60
30 " " " 7c 2.10
150 " " " 6c 9.00
100 " " " 5c 5.00
Total Gross Bill 17.95
CASH DISCOUNT:
1c. PER K. W. HOUR WILL BE DEDUCTED IF PAID
ON OR BEFORE 191

HOW PUBLIC UTILITY USES RUBBER STAMPS TO SAVE BILLING EXPENSE

A careful analysis of the bills developed the fact that 80 per cent of the customers were using somewhere from 1 kw.-hr. to 300 kw.-hr. per month, and a series of rubber stamps were secured numbered from 1 to 300, each of which bears the necessary calculation to cover that consumption. So that by merely stamping the bill the fixed service charge of 25 cents, which is added to all retail bills, and all the items on the sliding scale are covered in one operation. The billing clerk has these 300 stamps before him arranged in a handy rack, from which he can easily pick the proper stamp with far less risk of error than in hasty figuring. The only figuring now necessary on the bill in pen and ink is the discount allowed for prompt payment, a simple matter as 1 cent is allowed for each kilowatt-hour consumed during the month.

It has been found that the use of these stamps makes it possible to do the billing in one-third of the time formerly required, and with considerable more neatness, besides minimizing the element of incorrectness in totaling. General Manager Aicklen recommends this system to other managers and offers to send a full set of impressions from these stamps to any one who desires them.

SUCCESS WITH GIRLS HIRED AS METER READERS

Colorado Utility Finds that They Are More Accurate than Men, Besides Making a Better Impression Upon Housewives

While there has been some hesitation about employing girls or women as meter readers owing to the inaccessibility of some meters and the condition in which cellars are frequently kept, some companies are finding the employment of women in this connection very satisfactory.

The Arkansas Valley Railway, Lignt & Power Company of Pueblo, Col., has during the last few months been employing young girls in the meter department as meter readers and has found them to be fully as competent and dependable as men in the number of meters read, and, according to Superintendent E. F. Stone, "if anything, more accurate."

Approximately 90 per cent of the meters in Pueblo are in the residence district, which enables girls to read a great percentage of the meters. The girls are limited to this district. The company employs one young man as a reader who handles the commercial and industrial districts and also acts as a relief reader.

The girls are furnished with a leather case in which to carry book and flashlight. They are also furnished with an identification card, as shown. They receive the same compensation as the men formerly employed at this work. They are reading on an average twenty-five meters per hour, work from four to five hours in the morning and read "strays" or are employed in the shop in the afternoon cleaning and repairing meters.

By reading the meters in the morning and using the girls in the shop in the afternoons the company finds the number of "strays" greatly reduced, as a greater percentage of the people are away from their residences in the afternoon.

When a girl is employed as a meter reader she is first required to serve at least a week or ten days in the

shops cleaning and reading the shop meters. She must become efficient in reading shop meters before she is allowed to take a route.

The girls have met with little difficulty in obtaining admission to the homes to read meters. From com-

Form 214 3-15 500

Pueblo, Colo. Jan.1st.1918

To Our Customers:

This is to Certify, *That the bearer of this Card*

Miss Ruth Barr

is employed by this Company as Meter Reader

Customers will please admit him to their premises at reasonable hours for the purpose of reading, testing or inspecting meters or making necessary repairs.

This Card becomes void after Feb.1st.1918.

The Arkansas Valley Railway Light and Power Co.

(SGD) E.F.STONE

Supt. Lighting and Power

IDENTIFICATION CARD OF GIRL METER READER

ments that the company has received from the housewives, they prefer to have girls read the meters, and the results attained make it very likely that the company will continue to use girls in this work.

TEMPORARY RECEIPTS FOR GUARANTEE DEPOSITS

Brooklyn (N. Y.) Company Institutes New Method for Handling Customers' Deposits Collected by Salesmen

A new method of handling customers' guarantee deposits paid to collectors has recently been instituted by the Edison Electric Illuminating Company of Brooklyn, N. Y. Formerly it had been the custom for the collector to issue to the customer merely a memorandum receipt, very similar in character to the memorandum receipts which are commonly issued by banks in return for stock certificates left for transfer. It did not constitute a specific receipt for the amount of cash paid nor cover the full details, but was followed by a formal receipt in detail which was forwarded to the customer from the office. The result was that salesmen, collectors and branch office cashiers experienced more or less difficulty with any customer who did not feel that he was properly secured for the money paid down and was unwilling to wait for the formal receipt to come by mail.

The new plan has put in force a system of temporary receipts which are issued to the representatives in books of a convenient pocket size containing fifty individual receipts serially numbered, each receipt providing a temporary customer's receipt, a cashier's coupon and a permanent carbon which remains in the book. Whenever a deposit is now paid to a representative of the company a temporary receipt is given, and this receipt states plainly that a regular deposit certificate will be mailed within five days from the treasurer's office.

A cashier's coupon is also made out, and it accompanies the money when turned in. The supply of books is under the control of the cashier, who secures the employee's signature when the book is issued and signs for the empty book when the receipts are used up. An additional numerical control of individual coupons is secured by a system of tally sheets maintained by the cashier, on which he notes after each number the date the coupon was put through the records. It is a very simple method, requiring very little labor, and provides an absolute check against the proper receipt of every deposit which is paid to a representative of the company. The records of these deposits are kept on a series of cards that are operated by a tabulating machine.

Each book bears the name of the employee to which it has been issued on a special label which provides space for the transfer of the book to other employees. Careful instructions for the handling of these guarantee deposits are pasted on the cover of the book, as follows:

"Coupons and receipts should be written in ink. It is important that names, initials and addresses be correctly given. Legible carbon copies should be made on the duplicate (stub). Deposits turned over to branch office cashiers by agents should be receipted for on the duplicate. Deposits must be turned in to the company daily, accompanied by a correct copy of order. The space provided on the coupon for mailing address is to cover cases where party from whom deposit is received does not yet or will not reside at premises at which service is to be supplied. Consumers' deposit coupons are to be treated the same as cash coupons attached to electric bills. They are to be listed on the reverse side of collectors' 'daily collection sheets' under the heading of consumers' deposits, listing the number of the coupon as well as the amount of the total. This will constitute a permanent record of deposits turned in to the company and the receipt form attached to the collectors' 'daily collection sheet' should be properly made out by collectors and signed by person authorized to receive the money for the company. Collectors and branch office cashiers should carefully preserve all such receipts."

The new plan discontinues the practice of giving a self-addressed stamped envelope to customers paying deposits and provides a serially numbered temporary receipt to be held by customer until the permanent re-

◯ CASHIER'S COUPON No. 6871	TEMPORARY RECEIPT No.
CONSUMER'S DEPOSIT RECEIVED FROM	FOR DEPOSIT AMOUNTING TO $
NAME	DOLLARS
TO BE APPLIED TO	REGULAR DEPOSIT CERTIFICATE WILL BE MAILED
PREMISES	IF NOT RECEIVED WITHIN FIVE DAYS NOTIFY
AMOUNT $ DEPOSIT No	TREASURER'S OFFICE EDISON ELECTRIC ILL'G
MAIL DEPOSIT CERTIFICATE TO	CO. OF B'KLYN. 360 PEARL STREET BROOKLYN N. Y.
	FOR THE COMPANY

LEAF TORN FROM BOOK SHOWING TEMPORARY RECEIPT AND CASHIER'S COUPON

ceipt is received, thereby saving a great deal of time formerly used in explaining why no receipt was issued for the money received.

Not only that, but it minimizes the opportunity of customers suspecting the company of trying to defraud them of their money. It is always easier to prevent trouble than to make explanations later to an irritated customer.

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Notes on the Design of Electromagnetic Machines, Part III.—STANLEY PARKER SMITH.—In Part I of the article the author dealt with some of the main principles underlying the design of alternating-current generators. In Part II these principles were applied to the design of a low-speed, three-phase alternator, giving 750 kw. at 2200 volts when running at a speed of 250 r.p.m. In Part III the principles are applied to the design of a three-phase turbo-alternator to give 2000 kw. at 3000 r.p.m. at a line pressure of 5000 volts, and the mechanical stresses in the rotor are discussed.—London *Electrician*, Feb. 8, 1918.

Factors That Determine Maximum Rating.—F. T. HAGUE.—Commutation and temperature are the principal limitations to the ratings of direct-current machines, but the method of rating must be determined partly by the characteristics of the unit and partly by the service requirements. The limitations to rating may be considered as shifting, being extended as the knowledge of the theory involved is enlarged and as the skill in design and construction is improved. Most of the article is taken up with commutation limitations. Among the subjects discussed are commutator construction, maximum voltage, voltage per bar, flashing, maximum current, brush width, brush-current density, division of current between brushes, quality of brushes, armature reactance voltage, number of poles, and kw. versus speed.—*Electric Journal*, February, 1918.

Lamps and Lighting

Effect of Artificial Light on the Growth and Ripening of Plants.—J. L. R. HAYDEN and C. P. STEINMETZ.—A hitherto unpublished investigation of the application of electric light to stimulation of plant growth and fruition appears in the article. A description is given of the procedure, and the results are presented in the form of progressive photographs, tabulations and curves. Based upon these facts, the conclusions of the investigation show that under certain conditions electric light may be used with commercial success to accelerate the growth and development of plants.—*General Electric Review*, March, 1918.

Generation, Transmission and Distribution

The Unification of Frequencies.—ULISSO DEL BUONO.—The first installment of an extended study into this question, which the author purposes to discuss under four divisions: (1) Influence exerted by the alteration of frequency upon generating plants, prime movers and electrical machinery, and the modifications which ought to be made to enable machines to operate at a frequency different from that for which they were built; (2) influence of the alteration of frequency upon the lines, network and receiving stations and modifications necessary with a change in frequency; (3) general considerations upon cost and conditions of performance in the case of new machinery constructed for a given frequency; (4) methods of bringing about parallel operation of networks with different frequencies and examples of plants which have changed the frequency.—*L'Elettrotecnica*, Feb. 5, 1918.

Design of Underground Distribution for Electric Light and Power Systems.—G. J. NEWTON.—The object of this article is to show each step necessary in the design of an underground distribution system such as is usually required in a medium-size city. The operating conditions and municipal requirements are different in every locality; it is impossible, therefore, to make any definite rules that will apply under all conditions. By assuming the average conditions met with in the smaller cities it is possible to show the fundamental principles of handling this work in a systematic manner. While systems may and do differ, still it is possible to design a system for any type of distribution if these principles are followed. Where costs are given they are based on normal conditions and should not be taken as being the present costs. They are used simply for comparison, however, and will be of value in that manner only, and if treated as percentage difference will apply under any reasonable conditions. Owing to lack of space, no tables have been printed in this article as they can be found in electrical handbooks.—*A. I. E. E. Proceedings*, March, 1918.

Water Power Our Electrochemical Salvation.—C. A. WINDER.—The author undertakes to show that at least 50 per cent of the water now passing over Niagara Falls could be quickly and cheaply diverted for power purposes without in any way detracting from their natural beauties. In view of the serious coal shortage and the urgent need of electrochemical products, he contends that it is the duty of Congress to enact legislation at once which will make available the great quantity of energy now being wasted.—*General Electric Review*, February, 1918.

Installations, Systems and Appliances

Advantages of Electric Cooking.—Facts culled from the *Bulletin* of the Swiss Association of Electricians concerning the report of a commission on heating and cooking apparatus. Holding that the higher price of electric ranges as compared with gas ranges is counterbalanced by their superior safety and cleanliness, it follows that the essential condition of electric service is a charge not greater than that for gas. The daily consumption of gas for cooking is from 0.3 cu. m. to 0.5 cu. m. a person and that of electricity from 0.80 kw.-hr. to 1.04 kw.-hr. a person, the higher figure including the heating of water. Therefore it is necessary to sell 2.4 kw.-hr. at the same price as 1 cu. m. of gas. Since with the war the price of gas has risen from 18 to 20 centimes to 30 centimes (6 cents) a cubic meter, electric energy should therefore sell for 10 to 15 centimes (2 to 3 cents)

per kilowatt-hour—a price at which it is already sold by some central stations. It is objected that in many cases the existing electric installations are not able to take on the increased load that a general adoption of the electric range would cause. Much, however, can be done by tariffs adjusted to encourage the use of off-peak energy for cooking purposes.—*Revue Générale de l'Electricité*, Jan. 19, 1918.

Electricity in Beet-Sugar Factories.—E. M. ELLIS.—The article gives a readily intelligible description of the processes involved in the production of beet sugar and explains how greater reliability and economy can be secured by electrification. The many illustrations show the simplicity and flexibility of electric drive.—*General Electric Review*, March, 1918.

Testing Electric Ignition Apparatus.—J. D. MORGAN.—In connection with the testing of electric apparatus—namely, magnetos and induction coils—it is required to measure the current in the high-tension spark circuit. Owing to the complex character of the current, the problem of measurement is a difficult one. At the present, the author points out, the problem appears to be incapable of complete solution, and the task of producing a practical instrument resolves itself into devising means which will give useful indications when subjected to the actions of different currents having the same general characteristics. Different types of thermal instruments and varieties of the same type give very different accounts of the same piece of ignition apparatus.—London *Engineering*, Feb. 8, 1918.

Electrophysics and Magnetism

Aluminum Bronzes.—An exhaustive study of these alloys, both ordinary and complex, with regard to their electrical and mechanical properties, fabrication and industrial use. The electric resistivity of the ordinary alloy grows according to the content of aluminum until 7½ per cent is reached, after which it decreases. With 90 per cent of aluminum the resistivity approaches that for the pure metal. The temperature coefficient diminishes when the content of aluminum reaches 10 per cent. At 94 per cent it is virtually the same as with pure metal. The addition of minute quantities of aluminum to copper augments very sensibly the resistivity of that metal, but the addition of similar quantities of copper to aluminum hardly affects the resistivity of the latter.—*Revue Générale de l'Electricité*, Jan. 19, 1918.

Suppression of Hysteresis in Iron-Carbon Alloys by a Longitudinal Alternating Magnetic Field.—C. W. WAGGONER and H. M. FREEMAN.—Some remarkable experiments are described in which the disappearance of hysteresis was brought about by the action of an alternating magnetic field. It is possible, say the authors, that the explanation is to be found in the action of the eddy currents induced in the samples during magnetization. This point is being investigated further.—*General Electric Review*, February, 1918.

Units, Measurements and Instruments

A Recording Thermometer.—At the last meeting of the Physical Society Prof. C. V. Boys described a recording thermometer which is constructed to go into the case of a regulator clock. The thermometric element consists of a rod of ebonite within a glass tube. The differential expansion is determined by a pair of levers giving a movement of 1 in. for 10 deg. Fahr. (2.54 cm. for 5.5 deg. C.). The drum carries an ordinary barometer chart and is driven at such a speed that a two-hour interval of ⅛ in. (0.3 cm.) is passed in twenty-four hours. The drum is driven by friction by means of a cord. An alternative design on the same lines to go into a recording baragraph was also given.—London *Electrician*, Feb. 22, 1918.

Some Factors Affecting Determination of Maximum Demand.—CHESTER I. HALL.—A concise review of the development of maximum-demand rate systems is given in the introduction. Following this is a discussion of the four general methods of measuring maximum demand. Meters for this purpose are segregated into two subdivided classifications, the corresponding types being named. What constitutes an equitable time interval over which to integrate demand values is given consideration. A companion article is to follow.—*General Electric Review*, February, 1918.

Telegraphy, Telephony and Signals

The Mechanics of the Pole Line.—WARD H. SNOOK.—The determination of the forces acting on pole lines by use of graphics, deductions which may be made and applied to practical pole-line construction, and drop-wire construction and sags are discussed.—*Telephony*, Feb. 28, 1918.

The Telephone in the World War.—H. T. CARROLL.—The author describes the important part the telephone performs in the operations of the various armies. The war-time use of the telephone in the United States is also described.—*American Exporter*, March, 1918.

Miscellaneous

Turbo-Rotor Cap-Rings.—R. ROBERTS.—Conclusion of article from previous issue. The author shows how the stresses in turbo-rotor cap-rings may be calculated for some commonly used designs and summarizes the points that should be considered when designing the cap-rings.—London *Electrician*, Jan. 25, 1918.

Rolling Mills and the Electric Drive.—L. ROTHERA.—The power installed in British steel and metal works for driving rolling mills is now well in excess of 300,000 hp. This represents only a very small percentage of the total power employed in these industries, however. The advantages which can be claimed for the electric drive are, the author points out, the economy of working, reduced space taken up, ease of control, constant check on the power consumed, increased output from a given plant, more uniform drive and smaller initial cost. In applying electrical methods to large reversing mills several engineering problems have had to be solved. One arises in connection with the design of the flywheel, which acts as a reservoir of energy and flattens out the constantly recurring peaks experienced in rolling-mill practice. In order to keep the weight of the wheel down to a minimum very high peripheral speeds have been employed, and to avoid the risk arising from internal strains it has been necessary to design a special type of built-up wheel to insure good balancing.—London *Electrical Review*, Feb. 15, 1918.

Switch-Gear Standardization.—C. C. GARRARD.—The author considers the various parts of switch gear which can, in the present state of the art, be standardized with advantage and suggests adoption of the American standard test pressures for switch gear, giving specifications for brass and gunmetal. The article is to be concluded.—London *Electrician*, Feb. 22, 1918.

Scientific and Industrial Research

A Department Devoted to Interchange of Ideas, Investigations Contemplated, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF

Cornell University, Ithaca, N. Y.

CO-OPERATIVE RESEARCH BY WIRE AND CABLE MAKERS

They Purpose Investigation of Fundamental Nature of Dielectric Phenomena as a Foundation for Future Progress

At a recent committee meeting of the American Institute of Electrical Engineers Prof. Comfort A. Adams proposed a comprehensive system of co-operative research by manufacturers and others interested in the properties of insulating materials. He suggested that a committee be appointed consisting of representative experts in this field throughout the country who have facilities for carrying on research. This committee would lay out a plan of research, dividing the work between the various laboratories, and would meet periodically to compare results. In this way it is hoped that the fundamental nature of dielectric phenomena may be successfully investigated and a foundation laid for progress by all of the manufacturers participating.

The object of this committee would be to economize the efforts of the industry and to obtain results which are more thorough-going, comprehensive and commercially useful to them. Professor Adams said that he thought that this kind of co-operation will be necessary if we expect to compete with an organized nation like Germany after the war is over and that the organization of this committee will be the first step in one of the biggest movements for industrial supremacy. This plan has met with the approval of many manufacturers, and it is likely that the committee will be organized in the near future.

NEW RESEARCH LABORATORY IS ORGANIZED IN JAPAN

Provisions Made for Private Research, Dissemination of Information, Co-operation with Other Bodies and Training of Researchers

A new physics and chemistry research laboratory has been recently organized in Japan. It is a semi-governmental institution, part of the foundation being furnished by the government and the rest by private subscribers.

Several young scientists have been nominated as members of the staff, and some of them are at present in the United States studying laboratory methods. The noted physicist, Dr. Nagaoka, is the head of the physics department, and Dr. Ikeda is the head of the chemistry department. The object of the institution is to conduct original investigations in physics and chemistry and to apply the results for the promotion of industry. To accomplish these objects and to make the institution more closely related to the outsiders, the articles of incorporation contain the following provisions: (1) Private parties may apply for research to be done on specific subjects. (2) Outsiders may obtain permission to utilize the equipment of the institution. (3) Outside investigators may obtain assistance for completing their investigations or inventions. (4) The institution will publish the results of researches conducted in it. (5) The institution will provide public lectures for the dissemination of the results of its research. (6) The institution may confer honorary degrees upon those who have accomplished original research of merit. (7) The institution will conduct correspondence with other similar institutions of the world and co-operate with them. (8) The institute will undertake training of research men.

Investigations Under Way or Completed

(RESEARCH WORK REPORTED SINCE FEB. 16)*

CELLS, PRIMARY.

Investigations are being conducted to develop a primary cell that is light and practicable for use in connection with flash-lamps.—*E. J. Berg, Union College, Schenectady, N. Y.*

CORE LOSS.

An investigation and comparison of various methods for measuring the core losses in 2000-cycle transformers. Several methods were used for measuring the losses and the results compared.—*William B. Kouwenhoven, Johns Hopkins University, Baltimore, Md.*

CORONA, DIRECT-CURRENT.

An extensive study of direct-current corona has been made. Rectification of alternating current up to 45,000 volts effective has been accomplished with the corona tube in hydrogen. The effect of a hot wire on the corona discharge has been studied, and some very interesting facts have been observed. As soon as time allows, the research will be continued.—*Jacob Kunz, University of Illinois, Urbana.*

MAGNETIC HYSTERESIS CURVE.

Steinmetz's formula for hysteresis loss gives the integral value of the loop, but does not indicate the value of the hysteresis proper as a function of field strength or of induced magnetization. An attempt is being made to separate the three forces acting in magnetized iron, namely, field strength, magnetic tension and hysteresis. For any value of field strength their resultant determines the total magnetic flux density B. The hysteresis h for the upper branch of the loop seems to satisfy the following equation (similar equation holds for the lower branch): $h = A/\cosh\ (\phi - u)$, where $u = c\ (f + H)$, and $\cosh\ \phi = (1/\epsilon)\ \cosh\ \sqrt{a}(b + u^2)$. In these equations H is the field strength and A, c, f, a, b and ϵ are constants.—*Hans Lippelt, Brooklyn, N. Y.*

RESISTANCE TO THE GROUND.

With the usual methods of measuring the resistance between the ground and the earthing plates the result is vitiated by stray currents and by the emf. of polarization. The author has devised a method with which an ordinary Wheatstone bridge can be used with the addition of an adjustable emf. in the plate circuit. This latter emf. is set to compensate for that which exists between the plates and is due to the earth currents, electrolysis, etc., so that the bridge measures the true ohmic resistance of the ground connection.—*Shiro Sano, Tokio, Japan.*

TRANSIENT VOLTAGES, SPARK GAP IN AIR.

Experiments were performed on the behavior of a needle gap and of a sphere gap connected across the high-tension terminals of a testing transformer. Instantaneous voltages up to 35 kv. were applied by suddenly exciting the low-tension side with direct current, and it was found that under these conditions a needle gap can stand considerably higher transitory voltages than are shown in the A. I. E. E. table for continuous application.—*P. H. Felker, St. Louis, Mo.*

Suggestions for Research

INDUCED EMF., THE NATURE OF.

If a cylindrical condenser moves parallel to its plates in a field with its induction parallel to the plates and perpendicular to the motion, it becomes charged; but if the magnetic field between the plates is given the same relative motion while the condenser remains fixed, the condenser receives no charge. The experiments are of necessity more complicated than the corresponding experiments on rotation, especially in requiring the use of a magnetic arrangement analogous to the electric guard ring.—*S. J. Barnett, Ohio State University, Columbus.*

RECTIFIERS, COMMUTATOR-TYPE.

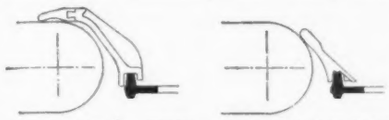
Theoretical and experimental investigation of a commutator-type rectifier driven by a synchronous motor. It is desired to improve the commutation by means of choke coils, condensers, etc., and to reduce the brush friction and energy loss. Such rectifiers are now being placed on the market for garages and for electrolytic work. Further development for heavier currents is desired, having in mind the electrification of steam railroads.—*Editorial Suggestion.*

*The names of individuals given after each institution reporting investigations are those of persons with whom others interested should communicate. All institutions reporting research work should give such names.

Preventable Waste of Coal

To the Editor of ELECTRICAL WORLD:

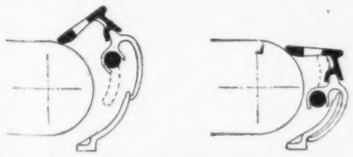
SIR: With reference to the abstract from D. M. Myers' interesting paper on the above subject contained in your issue of Dec. 8 I think it may be of interest to your readers if I give some particulars of two devices which we have had at work for some time at the Deptford power station, London, and which have proved to contain great possibilities in the way of coal saving when applied to chain-grate stokers on which it is necessary that many and



FIGS. 1 AND 2—FIXED CLINKER DAMS NOT SUITABLE WHEN WIDELY DIFFERING COALS ARE USED

varied grades of fuel should be burned.

Users of these coals will have noted their widely different burning characteristics on the grate. While, on the one hand, many classes of coal yield a close-lying, compact coke, many others, on the contrary, tend to "spread" on the grate in more or less open formation with isolated patches and intervening bare spaces, the latter condition making necessary some form of clinker dam or dumping bar at the rear end in order to hold the coal back and maintain a compact fuel bed until combustion is completed. The dam or dumping bar in general use has hitherto been of the fixed type, two well-known forms of which are illustrated in Figs. 1 and 2. We have found, however, that these fixed bars have very considerable limitations, as if made sufficiently high to bank up and retain efficiently the "spreading" classes of coal, the ash and clinker (frequently as much as 30 per cent in the poor qualities of coal we are having to burn under present war conditions) will not pass over but effect a lodgment on and in quite a short time choke up the grate, causing a serious loss in efficiency due to excess air admission and lowering of the furnace temperature. On the other hand, if

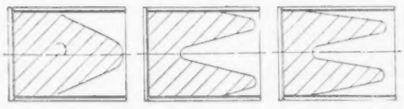


FIGS. 3 AND 4—ADJUSTABLE DUMPING-BAR SET FOR SPREADING COAL AND CLOSE-LYING COAL

made sufficiently low to clear the ash refuse, the grate fails to retain the "spreading" coal," not only allowing large quantities of unburned fuel to pass over the rear end but also resulting in a large amount of excess air admission due to the open formation of the fuel bed.

To overcome this difficulty one of the devices referred to above has been adopted. It consists of an adjustable dumping bar, one design of which is illustrated diagrammatically in Figs. 3 and 4. The dumping bars, of sectional type, pivot on supporting plates which make an air seal with a fixed "former" plate, this plate constituting the front side of the ash pit. The bearer bar carrying the sealing plate and dumping bar can be raised or lowered by hand, or preferably by means of a small hydraulic cylinder connected to the feed-water mains, the operating cocks being placed adjacent to the sight door at the rear end of the furnace. These dumping bars can therefore be set at the most suitable height for the particular fuel that is being burned, and should the accumulation of clinker require, it can be readily operated by merely lowering the bars for a few minutes until the débris has passed over, when they can be reset at the original or any suitable height. The main features of this apparatus are:

1. Flexibility of parts.



FIGS. 5, 6 AND 7—UNEVEN DISTRIBUTION OF COAL SOMETIMES OBTAINED ON GRATES

2. Wide angular rotation of the ash-receiving face.
3. Quick and ready renewal of parts.
4. Rocking or pushing back avoided.
5. Complete air seal in all positions.
6. Ease of operation.

The second device referred to above applies to the furnace door. One essential condition for good furnace efficiency is, of course, that the whole area of the grate up to the dumping bars should be equally covered by the fuel. Frequently, however, and more particularly in the case of the wider 8-ft. or 9-ft. stokers, the fire fringe assumes forms such as are indicated in Figs. 5 to 7. These irregularities or "legs," as the stokers call them, may be due to various causes, such as size and constitution of the coal, design of the chute feeding the coal hopper, or some feature in the design of the arch or furnace setting. It is also found that distortion and collapse of the type of guillotine door generally in use is not infrequent, more especially when burning fierce or highly volatile coals on a furnace setting which has been designed to give good front-end ignition with low volatile or low-grade fuels. We have found these difficulties almost entirely overcome by the use of the sectional adjustable door illustrated in Fig. 8, which it will be seen consists of a series of narrow doors suitably lined with firebrick and fitted with renewable shoes, each one separately and pivotally hung from a common bearer girder and individually adjustable, and so arranged that they may be collectively raised or lowered as required. Advantages of this design are, briefly:

1. Control of the fuel thickness and therefore of the distribution of the fire over the grate area.
2. Durability of parts.
3. Quick and ready renewal of burnt parts.
4. Freedom of working.
5. Effective air sealing.

The advantage of having the adjustment and flexibility of these two devices will, I think, be obvious to all users of chain or other traveling-grate stokers under any conditions of working with high or low grade fuels, but we have found them to be more particularly effective in greatly improving the efficiency of our boiler plant with the poor-quality coals we are at the present time having to handle. All who have had the experience of the unsatisfactory furnace conditions and poor efficiencies which usually are inseparable from a 25 to 30 per cent ash coal will, I think, realize the importance of an apparatus which can not only enable normally good efficiencies to be obtained but also show a marked improvement in steaming capacity.

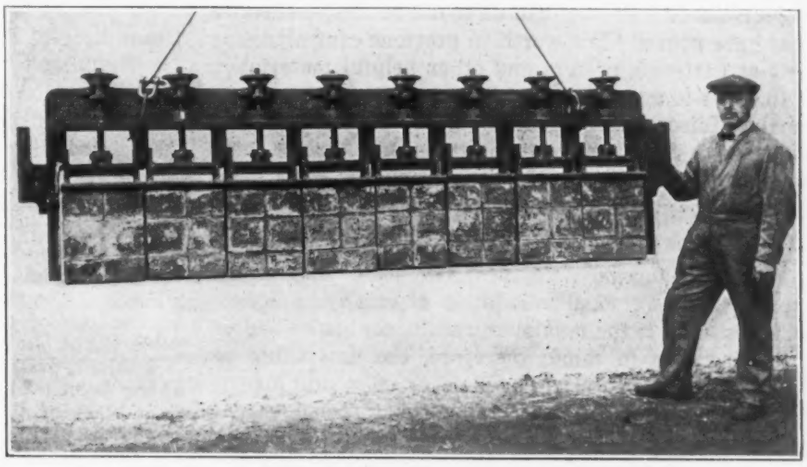


FIG. 8—SECTIONAL ADJUSTABLE GATE FOR INSURING UNIFORM FUEL BED

G. W. PARTRIDGE.
Engineer and Manager, London Electric Supply Corporation, Ltd.

Readers' Views and Comments

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

TIME TO PREPARE FOR THIRD LIBERTY LOAN

But Three Weeks in April Allowed—Speed Necessary to Make a Perfect Record—100 per Cent Subscription the Goal Set

With a definite date now set for starting the national campaign on the third Liberty loan—April 6—the campaign will be short and furious, only three weeks being allotted in which to obtain the required subscriptions.

Speed, therefore, is necessary, and it behooves every one to keep this factor in mind. Careful plans must be laid and every effort made to go well beyond the mark set.

In the first two loans the individual subscriptions, while large, were by no means so great as they might have been. The subscriptions in large blocks from the financial centers were the predominant features.

The third loan, however, demands a much wider distribution than either of the other two. The fifty-dollar and hundred-dollar subscriptions must far exceed their number in either of the two previous loans.

Consequently there is a direct obligation on the part of every employer to see that his employees have the opportunity to subscribe 100 per cent. Those in the electrical industry have backed the other two loans magnificently. Their efforts on these occasions, however, must fade into insignificance compared with what they are to do in the three allotted weeks in April.

To sell every employee a bond is the task set the industry. To help the industry in this work by the suggestion of how it can be done is the task of the ELECTRICAL WORLD. In these pages each week until the loan is pronounced a success will be found details of schemes that have proved their worth in previous campaigns, as well as cartoons, posters and other helpful material.

In order to make the third Liberty loan another thorn in the Kaiser's side manufacturers, central stations, jobbers, dealers, contractors, engineers, agents, etc., must begin *now* to lay the foundation for their campaign in their own shops, offices and plants.

PERSONAL SOLICITATION NECESSARY

First and foremost the first two loans taught one great lesson. Personal solicitation of employees is necsary—without it the maximum results cannot be had.

Bearing this in mind, therefore, the first thing to do is to organize the shop or plant or office into a committee or committees—preferably the foremen or department heads. They should be told exactly how it is proposed to sell to the employees, namely, whether the company will carry the account and, if so, on what basis. They should be educated, if they are not already so educated, on the fundamental idea back of the Liberty loans and their enthusiasm aroused. Enthusiasm is the keynote. Without it the solicitor will not be successful.

Other preliminary work will include procuring, if it is not already at hand, a bulletin board at least 9 in. by 12 in. in size. Naturally this should be placed where the men are in the habit of gathering.

Subscription blanks and any other stationery also should be prepared ahead of time. Posters for hanging up in all the places that the men work or gather can be procured from the local Liberty loan committee and should be on hand and hung up when the campaign opens.

The ELECTRICAL WORLD is preparing two posters which will appear prior to the beginning of the national campaign and which will serve as original posters for bulletin boards. Besides, the ELECTRICAL WORLD is laying in a supply of stickers for letterheads, printed in three colors, which may be had for $3 a thousand. These stickers are free from all except Liberty loan advertising.

Lastly, let the local committee help. Let no stone remain unturned. The goal set is 100 per cent subscription.

For several reasons the desire for greater distribution of the loan seems likely to be fulfilled. First, America is now very much in the war—*our* soldiers are holding long stretches of first-line trenches and consequently the national realization of the war is now much more acute. Second, the education on the first two loans will serve as a foundation for the third. Third, wage earners are in a better position than ever to save.

USE OF TRADE ACCEPTANCES URGED BY MANUFACTURERS

Committee of Associated Manufacturers of Electrical Supplies Shows that They Will Be of Great Value, and Governors Act

At a recent meeting of the board of governors of the Associated Manufacturers of Electrical Supplies the following resolution on trade acceptances was passed:

Whereas the board of governors of the Associated Manufacturers of Electrical Supplies has investigated by committee the general question of the employment of trade acceptances; and

Whereas the reports of such committee indicate that the general use of trade acceptances would be of exceeding value to the electrical manufacturing industry,

Resolved, first, that the board urge upon the membership of the Associated Manufacturers of Electrical Supplies the desirability of the immediate adoption in their respective businesses of the trade acceptance; second, that members not fully acquainted with the methods and processes employed be urged to communicate at once with the committee on trade acceptances and obtain the information necessary to a thorough understanding and ultimate adoption; third, that the committee consisting of Messrs. Eidlitz, Trumbull and Dustin be continued and instructed to extend by all proper methods throughout the electrical manufacturing industry the use of the trade acceptance; fourth, that a copy of this resolution be mailed to all members of the Associated Manufacturers of Electrical Supplies.

MINNESOTA ASSOCIATION IN WAR-TIME CONVENTION

Members Meet at Minneapolis Because They Feel Need of a Conference to Consider Problems Growing Out of the War

The first war-time convention of the Minnesota Electrical Association was held at Minneapolis on March 11, 12 and 13. The registered attendance was larger than it had been at any time before in the association's history. The members had expressed a desire for a convention as a war-time necessity and came to the meeting to learn how other companies are solving the new problems presented by war conditions. The keynote of the convention was conservation. Keen interest was displayed in papers and discussions on all plans for effecting true economies.

President F. A. Otto of Albert Lea departed from the usual type of presidential address and made several definite recommendations. He said in part:

Considering the question of holding a meeting this year, the board of directors of the association was unanimously of the opinion that the abnormal conditions caused by the war made it more necessary than ever to get members together for their mutual co-operation in maintaining the central-station industry at maximum efficiency.

The work of operating a public utility is becoming more and more difficult and the end is not yet in sight. Delays and inability to get fuel and the increasing cost of coal, as well as the rising cost of labor, have added materially to the operating expenses.

Difficulty in financing new extensions and securing new capital have added to the troubles; shortage of material, transportation delays, curtailment in lighting and power have all tended to reduce revenues of central stations. For these reasons and many others it seemed necessary to call members together.

The president then recommended that a fuel committee be appointed with the following objects:

1. To make a survey of the coal situation in the State as it affects public utilities. By this is meant to ascertain the amount of coal consumed annually by the public utilities and the monthly consumption, and to ascertain how much coal can be stored by each utility. This will show how much coal must be transported.

2. To co-operate with the State Fuel Administrator to secure the necessary supply of coal and to co-operate with railroad operators to keep coal moving regularly.

3. To give special assistance to association members who have difficulty in getting a sufficient supply of fuel.

Mr. Otto further urged emphatically that since the central stations are of first importance as a national asset in war time no effort should be spared to maintain them at maximum efficiency in spite of all difficulties. To this end he recommended that the work of the technical committee be enlarged so that any association member could secure assistance in maintenance.

S. B. Hood, superintendent of construction Northern States Power Company, presented a paper on proper grouping of transformers in an interconnected secondary network. This paper was a résumé of two articles on the same subject presented in earlier issues of the ELECTRICAL WORLD. Mr. Hood stated that the fuses which are essential to the success of his plan will be marketed soon by a well-known manufacturer.

The discussion indicated interest in this plan as a method of increasing the possible load a given distribution system can carry.

George A. Hughes, president Edison Electric Appliance Company, delivered an inspiring address on how electricity can be used to conserve people and materials. He pointed to the wide difference between the two words "conservation" and "conservatism," the meanings of which are sometimes confused. "Conservatism" means "do not do anything new," while "conservation" means "hasten to do the new things to be constructive."

Mr. Hughes' paper was discussed by H. E. Young and George D. Shepardson, Minneapolis, and Leonard Peterson, Thief River Falls.

Other papers presented, of which more will be published in later issues, were: "Maintenance of Electric Meters," by George Hewitt, Minneapolis; "Iron Wire Transmission Lines," Prof. W. T. Ryan, Minneapolis, and "Minnesota Water Powers," R. D. Thomas, St. Anthony Water Power Company, St. Anthony Falls.

Officers for the ensuing year were elected as follows: President, B. W. Cowperthwait, Faribault; vice-president, H. E. Swanson, Rochester; secretary, Fred C. Hoffmann, St. Paul; directors, Emil Aveldson, Litchfield, and H. E. Young, Minneapolis.

TENTATIVE A. I. E. E. PROGRAM FOR ATLANTIC CITY CONVENTION

Five Technical Sessions to Be Held at Annual Convention—Tentative Program Prepared for the June Meeting

It has been decided to hold an annual convention of the American Institute of Electrical Engineers in Atlantic City, N. J., on June 26, 27 and 28, 1918. Five technical sessions are contemplated.

The tentative program for the annual convention was decided upon by the committee on meetings and papers at the regular meeting in Cleveland last week. The following papers are considered as convention possibilities and will be presented in the order named if they are submitted and accepted by the committee on April 25:

Wednesday, June 26, 2.30 *P. M.*—W. H. Cole, "Split-Conductor Cables—Balanced Protection"; E. B. Meyer, "Overhead Cables"; H. H. Cochrane, "Wood-Stick Insulators"; G. I. Gilchrist, "The Applications of Theory and Practice of Transmission Systems."

Thursday, June 27, 10.30 *A. M.*—C. T. Allcutt, "Lightning-Arrester Spark Gaps"; C. P. Steinmetz, "Oxide-Film Lightning Arrester."

Thursday, June 27, 8.30 *P. M.*—E. Kilburne Scott, "Nitrogen Fixation"; C. P. Steinmetz, "America's Power Supply"; D. C. Jackson and N. W. Alexander, "Education."

Friday, June 28, 10.30 *A. M.*—V. Karapetoff, "Charged Condensers"; C. L. Fortescue, "Method of Symmetrical Coordinates Applied to the Solution of Polyphase Network"; N. S. Diamant, "Flux Distribution in Alternators Under Sustained Short-Circuit Conditions and Different Loads."

Friday, June 28, 2.30 *P. M.*—J. J. Linebaugh and J. L. Burnham, "Protection from Flashing for Direct-Current Apparatus"; H. S. Osborne, "The Design of Transformers for Parallel Telephone and Power Circuits."

The meeting will open at 10.30 a. m. on Wednesday, June 26, with an address by the president, and an informal reception will be held at the Marlborough-Blenheim Hotel at 8.30 the same evening.

The committee on meetings and papers has decided to recommend to the board of directors to hold a joint technical session with the American Physical Society at the annual fall meeting at Philadelphia in October.

CLEVELAND A. I. E. E. MEETING WITH THE STEEL ENGINEERS

Standardization of Motors Evokes Lively Discussion in Joint Meeting with Association of Iron and Steel Electrical Engineers

The important topics discussed at the intersection meeting of the American Institute of Electrical Engineers at Cleveland, March 8, 1918, were "Motor Standardization for Steel Mills," "Selection and Control of Steel-Mill Auxiliary Motors," "Capacity of Rolling-Mill Motors" and "Underground Distribution for Electric Light and Power Systems."

At the evening technical session President E. W. Rice, Jr., of the A. I. E. E. and President C. A. Menk of the Association of Iron and Steel Electrical Engineers presided jointly. Both manufacturer and consumer were given the opportunity to discuss the problem of motor standardization in steel mills.

W. L. Snyder, chairman standards committee of the Association of Iron and Steel Electrical Engineers, made a plea to the electrical engineers to help standardize electric motors for the steel industry. Lantern slides showed the labor and expense involved in changing the type of motor on various machines. Size of bases of motors and distances between bolt holes vary widely, and new frame castings had to be placed on the machines shown on the screen to hold the motors in position. Mr. Snyder mentioned several reasons for the need of standardization. He quoted a letter from the Midvale Steel & Ordnance Company which stated:

"Of approximately 800 crane motors now in use in this plant, 400 are of one type, which we have chosen as a standard, the other 400 being of miscellaneous makes and types. For the 400 standard-type motors we require twenty-eight duplicates to keep them in operation, whereas for the 400 miscellaneous motors 116 duplicates are necessary. If all 800 motors were of the standard type, only forty duplicates would be necessary and a saving of 73 per cent in duplicates would be effected."

"There are approximately 1,000,000 motors in the allied steel industries to-day," said Mr. Snyder, "which require 200,000 spares, costing $8,000,000. If the motors were standardized, only 50,000 spares would be needed and an investment of $6,000,000 avoided."

The paper was discussed by T. E. Tynes, B. J. Beck, D. M. Petty, H. C. Cronk, E. Friedlaender, A. D. Nye, A. W. Cowles and President E. W. Rice, Jr. Mr. Tyne said that when crane motors are to be replaced, which is bound to happen in time, it is usually impossible to procure the same type of motor. Therefore the trolley systems on the cranes would have to be redesigned.

Mr. Becker told of the troubles he had experienced from a manufacturer changing two types of motors twice in ten years. There were several questions upon such points as the advantages of straight or tapered shafts and interpole or straight series motors that Mr. Becker thought ought to be settled before standardization was effected.

Mr. Petty pointed out that the engineers should thoroughly consider what standardization meant to the manufacturers as well as to the consumers, because additional expenditures would be necessary to enable the manufacturers to discard their present-type motors and adopt the standard.

Mr. Hess said that the Youngstown (Ohio) Sheet & Tube Company carries a stock of 244 different-size brushes for the 2500 motors in the plant, which involves an investment of $50,000. If these brushes were of one type, a saving of $32,000 to $38,000 could be made.

Mr. Friedlaender startled the convention by asking: "How are you going to do it? Who makes the best motors?" He pointed out that standardization would retard future improvement in design and said that it would be best for the engineers to standardize their opinions before trying to standardize motors.

Mr. Nye said that if the demand were great enough the manufacturer would have to supply a standard motor and that a motor should be designed and submitted to the manufacturers.

President Rice pointed out that the manufacturer is in favor of standardization methods because the producing cost is greatly reduced. But he thought that standardization should come by evolution and not by revolution. He suggested that a committee of engineers be appointed to develop a standard and that manufacturers should be allowed to attend these meetings and advise concerning the design.

Selection of Steel Mill Auxiliary Motors

In a paper entitled "Selection of Steel-Mill Auxiliary Motors and Control as Affected by Mechanical Features of the Drive," J. D. Wright showed illustrations of complete electrically equipped steel mills. He explained the function and operation of manipulators for blooming mills, which consist of side guards and lifting fingers. Traveling tilting tables were shown, and Mr. Wright pointed out the necessity of having motors reversible and with solenoid control for inching work.

In the discussion that followed the presentation of the paper it was generally held that rolling-mill motors should be of the high-speed series type instead of the special low-speed machine, because the series motor is more easily controlled. It was pointed out that more clearance was needed on the side guards in the mill housing of rolling tables. That a buffer resistance instead of a jam relay should be used on the side guards, because the jam relay does not have time to act, was contended by several speakers, but Mr. Wright, in closing the discussion, stated that the machine in question had been originally equipped with a jam relay which had to be discarded as being unsatisfactory.

Capacity of Rolling-Mill Motors

"Some Considerations in Determining the Capacity of Rolling-Mill Motors," by R. F. Hamilton, was presented by W. Sykes somewhat briefly because of the mathematical calculations involved in the paper, which held that classification of motors, mathematical determinations of energy required for rolling, relation of speed to tonnage, motor capacity and flywheel application should be thoroughly studied in the application of electric drive to rolling mills.

In closing the discussion Mr. Sykes stated that the designer should start with the idea of what he wants to roll. He emphasized the fact that the motor should be used in the type of mill for which it is designed and that all calculations for capacity should be made with ultimate needs in view.

That rolling-mill motors should be designed for reliability as the chief consideration was the main thought

in the discussion. If a steel mill is shut down for an hour, a large loss is entailed, and therefore continuous operation should be considered first. It is not the manufacturer's duty to design the correct type of motor, but the industrial engineer should tell exactly what is wanted because he knows the conditions of the plant.

UNDERGROUND ELECTRIC DISTRIBUTION SYSTEMS

The complete design of an underground system was described in a paper by G. J. Newton entitled "Design of Underground Distribution for Electric Light and Power Systems." The author realized that all systems differ and that it would be impossible to make definite rules that would apply under all conditions. He made clear, however, what information is necessary and told how, after getting that information, the design should be made.

The paper was discussed by A. A. Myer, G. N. Rakestraw, H. T. Wallau and E. Friedlaender.

Mr. Myer told of the direct-current underground system used in Detroit and pointed out that the load density was an important factor involved in the design of an underground system.

Mr. Rakestraw recommended the use of varnished cambric insulation for underground cables instead of paper in spite of the fact that paper is more economical. He also advised against the use of a bare-wire neutral connection to ground in an underground system.

Mr. Friedlaender told of the troubles of an underground system in steel mills because of maintenance. If a break occurs, it can be more easily and quickly remedied on an overhead line than on the underground system.

ANNUAL MEETING PLANS OF ASSOCIATED MANUFACTURERS

Convention on March 21 in New York Will Include Afternoon Business Session and Banquet in the Evening

As stated in last week's issue of the ELECTRICAL WORLD, the annual meeting and banquet of the Associated Manufacturers of Electrical Supplies will be held at Delmonico's, New York, on Thursday, March 21.

The business session is called for 2 p. m., for election of governors, presentation of reports, etc., and for consideration of international trade conditions after the war, trade acceptances and their advantages, the work of the war service committees and many other matters of interest.

The evening session, with a banquet, to which members may invite guests, will be a social session, in the grand ballroom of Delmonico's, at 7.30 p. m., and will be strictly in keeping with the condition of the times and the war situation.

A most interesting program has been arranged, with entertaining speakers, excellent music and other attractive features. Major Donald Guthrie of the British army, who has been in a number of battles in France and was wounded severely, will speak at the banquet.

The entertainment committee is Le Roy Clark, J. W. Perry and Charles E. Dustin.

A revised schedule of the section and committee and other meetings to be held in the association rooms, 30 East Forty-second Street, New York, during the week of the annual meeting follows:

Monday, March 18, 1918.—Interlocking standardization committee, 2 p. m.

Tuesday, March 19.—Inclosed fuse committee, 10 a. m.; Snap Switch Section, 10 a. m.; Molded or Formed Insulation Section, 10 a. m.; Lamp Receptacle and Socket Section, 2 p. m.; Outlet Box Section, 2 p. m.; Industrial and Street-Lighting Fixture Section, 2 p. m.; Attachment Plug Section, 4 p. m.; Insulating Materials Section, 4 p. m.

Wednesday, March 20.—Panelboard and Switchboard Section, 10 a. m.; Fuse Section, 10 a. m.; Fan Motor Section, 10 a. m.; Knife Switch Section, 2 p. m.; Non-metallic Conduit Section, 2 p. m.; Metallic Flexible Conduit and Armored Conductor Section, 4 p. m.; inclosed externally operated switches, immediately following Knife Switch Section meeting.

Thursday, March 21.—Annual meeting of the association, 2 p. m., at Delmonico's, New York; social session and banquet, 7:30 p. m., at Delmonico's.

Friday, March 22.—Magnet wire committee, Wire and Cable Section, 10 a. m.

HEARINGS ON ADMINISTRATION BILL TO GOVERN WATER POWER

Special Committee Has Set Aside Whole Week to Hear Testimony of Investment Bankers, Engineers and Utility Operators

The special committee of fifteen having in hand a so-called "administration" water-power bill, which creates a federal power commission to provide for the improvement of navigation, for the development of water power, for the use of land in the United States in relation thereto and for other purposes, has set aside the week beginning March 18 for hearings on the measure. The bill, which is the proposed House substitute for Senate bill 1419, has been modified to include recent suggestions made by the Secretary of War, Secretary of the Interior and Secretary of Agriculture. These three will constitute the water-power commission. The measure, as has been previously pointed out, also provides for an executive officer of the commission, appointed by the President for five years, for the payment of rentals and for licenses for water power on public lands as well as public streams for fifty years.

At the end of the license period the licensee will be allowed to renew the license and remain in undisturbed possession until the proposed commission shall have done one of three things:

1. Issued new licenses under laws then applicable.
2. Given licenses to new licensees who shall pay for the net investment of the licensee in the project.
3. Taken the property over upon paying the net investment of the licensee in the project plus reasonable damages for all property not taken over and damaged by reason of severance.

"Net investment" is given as the actual legitimate original cost as defined and interpreted in the "Classification of Investment in Road and Equipment of Steam Roads," issue of 1914, Interstate Commerce Commission, plus similar costs of additions thereto and betterments thereof, minus the sum of the following items properly allocated thereto, if and to the extent that such items have been accumulated during the period of the license from earnings in excess of a fair return on such investment: (a) unappropriated surplus, (b) aggregate credit balances of current depreciation accounts, and (c) aggregate appropriations of surplus or income held in amortization, sinking fund or similar reserves, or expended for extensions or betterments.

Closing Inefficient Plants to Save Fuel

CONTINUING further its investigation into isolated plant and central-station conditions in New York City, the Public Service Commission, First District, held a hearing on March 11. C. E. Stuart, of the utilities section of the conservation division of the Fuel Administration, was present again as a representative of the Washington authorities.

Mr. Stuart had placed in the record of the proceedings a full statement of the purposes of the federal Fuel Administration in concerning itself with the case.

Supplementing this statement, Mr. Stuart said later to a representative of the ELECTRICAL WORLD that the investigation in which the Fuel Administration is interested is proceeding not only in New York, but also in different ways in other sections of the country. It is possible that one of these investigations will furnish a basis for a broad general solution.

It is proposed to treat every case on its merits, and Mr. Stuart said that the Fuel Administration is anxious that this shall be understood thoroughly. There is no intention, for instance, of issuing a broad, sweeping order condemning inefficient plants.

Some plants can be diverted to central-station service with economy; in others remoteness of location, necessary interior or exterior construction or other considerations would make it inexpedient.

CASES INVOLVING DUPLICATE SERVICE

In addition to the issue affecting isolated plants, Mr. Stuart said that the Fuel Administration is also looking into cases where private and municipal plants are duplicating service. In one Indiana community where this condition existed the local authorities combined, without the influence of the Fuel Administration, to close the inefficient plant.

In his formal statement to the commission Mr. Stuart said in part:

The experience of the past winter has shown that on account of the transportation congestion and other conditions caused by the war some curtailment of the previous rate of fuel consumption by the community is necessary. This curtailment was effected during the past winter by cutting off light, reducing heat, shutting down factories, etc. These methods cause serious inconvenience and loss to many, and it is therefore obviously desirable to secure the necessary economies in the future in less drastic ways, if this is at all possible.

The individualistic way in which fuel is now consumed in cities is not efficient. A ton of coal burned in a large central station will produce at least four times as much electric power as if burned in the average small plant, and if centralized burning could be introduced to a greater extent, the amount of fuel required could be largely reduced without reducing in any way the ultimate production of light and power.

It may be generally stated that in buildings where electric plants are located and where exhaust steam from engines is utilized in the heating of the building, furnishing hot-water requirements and possibly providing a very small amount of steam for industrial and other processes, such a building can readily adopt central-station service without a loss of money and at a large percentage of saving in fuel.

In many other cases it might be more economical from the standpoint of fuel saving to utilize isolated electric plants in conjunction with central-station service. The ideal arrangement would then be to use the combination of services in such a way that no exhaust steam would be sent to the atmosphere to be lost.

It is the duty of the Fuel Administration to devise means for securing a curtailment in the use of fuel in ways which will impose a minimum of hardship. It is believed that there are many plants not only in New York but throughout the entire country which could, at least temporarily, shut down their own electrical machinery and purchase power from others at a financial advantage to both parties and with a considerable saving in fuel.

The subject considered more broadly will affect even the question of whether or not certain central stations now in operation can be economically continued in operation.

There are localities in the country where there is an excess of hydroelectric energy and where at the same time coal-burning central stations are in operation. The saving that could be effected by shutting down the coal-consuming plant, provided it is practicable to do this, is evident. If it be possible to make necessary connections, enabling the shutdown of the coal-consuming plant, it would simply mean that the hydroelectric plant would carry the load of the coal-consuming plant, and it would become a question of an adjustment of rates so as to conserve the interests of the public and of the coal-consuming plant through the period of shutdown.

While it may appear that the interests of the central station are being benefited to a large degree, such is not of necessity the case. In some cases central stations may be shut down. In any event, any connection between a central station and a building or a manufacturing plant that is affected will of necessity be for the period of the war only or through the period where the coal situation is critical. The machinery of the isolated plant can be readily preserved through this period of necessity. Under these circumstances the heavy expense attendant upon the making of the connection by the central station may completely or even more than offset any profit which could be expected of such a load through a short period.

In those cases where small electric plants are closed down entirely there will be a larger number of men available than in cases where a partial closing down is brought about. In any event these skilled men are vitally needed in many of the war industries of this country.

Again, the conservation efforts of the Fuel Adminstration are being directed in order to conserve the interests of all with the least inconvenience and cost and with the object of making the coal supply that is available go just as far as possible and to prevent the necessity of further drastic measures such as were necessary in January.

The administration at this time has no idea of attempting to bring about any such result by means of orders, or even of suggestions that fuel be saved by the closing of isolated plants, where this would cause hardship to the owners not commensurate with the benefit derived by the public. It is interested in the present hearings, however, in the hope that they will set forth the facts and also the savings which are possible in certain cases in so convincing a way that each plant owner will consider himself a volunteer member of the administration, charged with the duty of investigating his own condition in a non-partisan way and where circumstances warrant it of taking the necessary steps to secure the saving.

J. W. Lieb, vice-president and general manager New York Edison Company, made an extended statement before the commission bearing on the main and collateral questions raised in the investigation. The Fuel Administration is interested in the possible coal economies, and the Public Service Commission is raising also the question of rates.

Mr. Lieb read a statement, in part as follows:

The company had no knowledge whatsoever as to the purpose of the commission in issuing its order calling for these hearings, and it has taken no steps whatsoever with the commission or elsewhere in the direction of agitating or promoting any movement having in view the shutting

down of isolated plants and the substitution therefor of central-station service. It has not attempted in any way to take any advantage of the present situation to urge upon any public authorities, national or local, the desirability of closing down isolated plants as a measure of fuel conservation, nor has it initiated or prompted any action whatsoever toward enlisting their interest or support in such a movement.

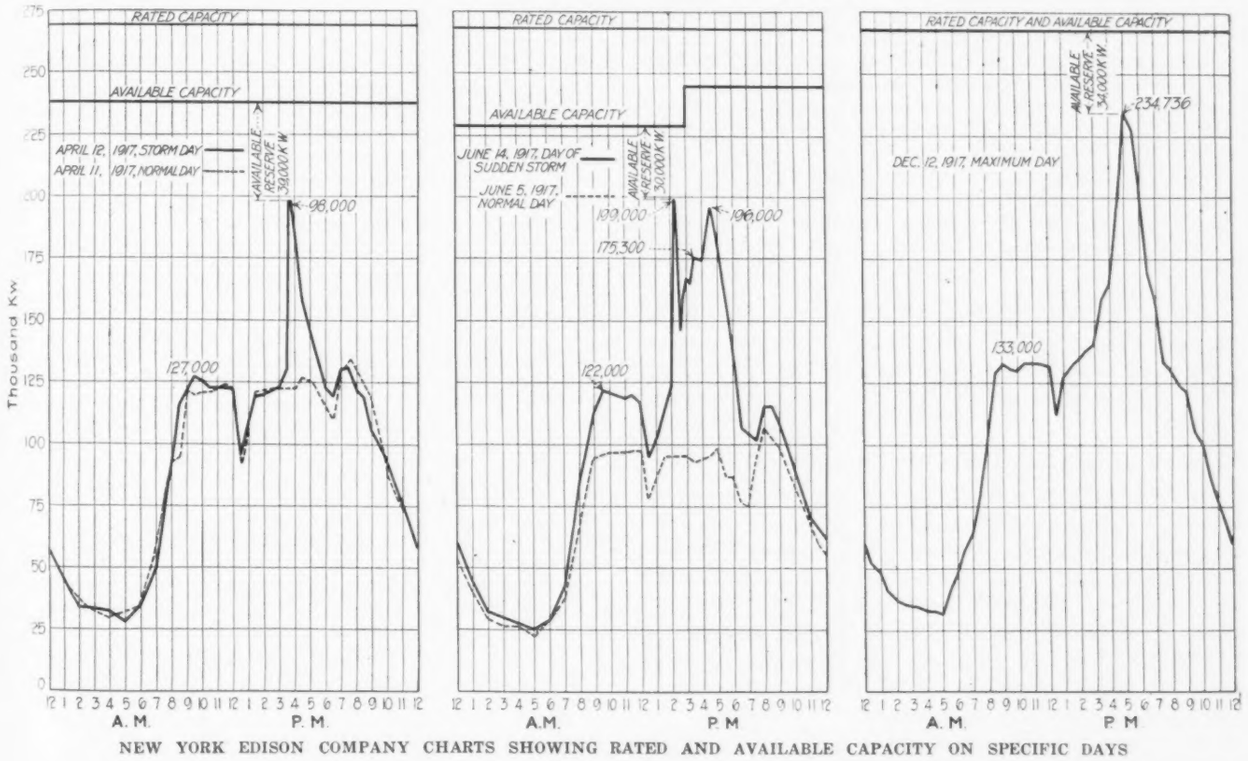
It would appear from the opening remarks of the presiding commissioner that this was to be a hearing on fuel conservation; we find it to be in reality a rate hearing, the commission's order making no reference whatever to the subject of fuel conservation.

We are prepared to give "segregated" service as an auxiliary to private plants at our regular rates without any limitations whatsoever. We are also prepared to give breakdown and auxiliary service to isolated plants at the standard rates for this service provided for in our rate schedule. We are not, however, prepared to furnish breakdown service to a so-called block lighting plant, which is not a customer's own plant furnishing service for himself alone, but is in effect a small central station supplying energy to a number of customers outside of the building in which the plant is located, making it an actual competitor of the lighting companies, one over which the commission has not, however, assumed jurisdiction, these block lighting plants paying no franchise taxes and escaping the regulatory obligations and control as to rates, standards and conditions of service, etc., that are imposed on lighting and power companies by the Public Service Commission law and the statutes of the State.

The company in 1908, at the request of the commission and with its co-operation, established a rate which met its full approval, mistakenly, however, called a "breakdown" rate, providing at the same time and under one rate for breakdown, insurance, emergency, auxiliary and supplementary service to buildings obtaining their service normally from private plants installed on the premises. That this service and the rate and conditions under which it is given have been satisfactory and to their advantage would seem to be attested by the fact that over one-half of all the isolated plants on Manhattan Island have availed themselves of it, and the number is increasing, particularly during the last few months.

We now learn from the testimony so far adduced that it is the endeavor of operators of isolated plants to obtain a special reduced so-called "off-peak" rate for this class of service, notwithstanding the fact that the present rate was arranged for with the approval of the commission to cover just such service under normal conditions and not under such extraordinary conditions as exist at the present time. We shall show by the incontrovertible facts of our experience that under the conditions prevailing on Manhattan Island this service is not an "off-the-peak" service. We are put in the position of presenting testimony now and at this of all times for what seems to be to all intents and purposes a rate hearing having for its primary object not primarily the elucidation of facts in regard to the conservation of fuel but an endeavor to obtain a reduced rate for a special temporary service amply and reasonably provided for, in character of service and rate, by our standard rate schedule.

We may be called upon to present such data as we may be able to prepare on the question of the rate for this service in relation to its cost, but we wish now to place on record our emphatic protest against being required to participate in a rate hearing at this time. It appears to us most unreasonable and unfair to consider what in effect is the question of the lowering of rates under conditions when no man can foretell what the morrow may bring forth and under circumstances of such uncertainty, precariousness and dismal outlook that, as the commission well knows, the company is even now seriously considering the necessity of coming before it and asking for a general increase of rates.



NEW YORK EDISON COMPANY CHARTS SHOWING RATED AND AVAILABLE CAPACITY ON SPECIFIC DAYS

In submitting the accompanying curves Mr. Lieb said that it should be noted that this diagram is not strictly correct, it does not show conditions as they really are.

The April and June loads are not on the same basis as the December load. As a matter of fact there was a larger connected load in December than in April or June owing to the fact that many new installations were added to the system between these dates.

If this additional load had been on the system on the dates shown in the April-June curves, the actual peak loads on these dates would have been considerably larger and the reserve capacity as compared with winter conditions would have been still smaller.

CONSTRUCTION OUTLAYS LARGE FOR TELEPHONES

Capital Expenditures in 1917 for Bell System Reach $118,600,000—Maximum Requirement for 1918 Estimated at $90,000,000

Heavy capital expenditures for plant additions made necessary by the war are an outstanding feature of the annual report of the American Telephone & Telegraph Company for 1917. The net amount added to plant and real estate by all companies, excluding connecting companies, constituting the system in the United States was $118,599,462. This compared with $66,224,700 in 1916 and was larger than for any previous year by nearly 50 per cent.

Concerning the results of the policy adopted and outlining the probable construction requirements of 1918, Theodore N. Vail, the president, says in the annual report to stockholders:

The continued policy of the Bell system of constructing in advance of requirements, partly to provide for emergencies, and for economical reasons, has again justified itself many times over during the year.

It is difficult to estimate what additions will be made to the plant during 1918. Plans have been made aggregating $90,000,000. This is believed to be the maximum requirement; the probabilities are that much less will be expended. The government's desire for the conservation of men, material and money for direct war requirements and the difficulties of transportation because of priority orders and freight embargoes make the exact determination of the program impossible.

The net capital addition of $118,599,462 was distributed as follows: Real estate, $13,770,614; equipment, $28,029,466; exchange lines, $41,565,583; toll lines, $25,834,824; construction work in progress, etc., $9,398,975.

Total Operating Revenues Nearly $300,000,000

In round figures the total operating revenues of the Bell system were $294,900,000, an increase of $30,300,000, or 11.5 per cent, over last year. Of these revenues depreciation and maintenance consumed $94,071,000, an increase of $9,515,000 over 1916, or 11.3 per cent; traffic expenses consumed $68,122,000, an increase of $14,373,000, or 26.7 per cent; commercial expenses, $28,364,000, an increase of $2,665,000, or 10.4 per cent; general and miscellaneous expense, $13,850,000, an increase of $1,947,000, or 16.4 per cent; taxes assignable to operations, in which provision is made for the estimated amount of federal income and excess profits taxes payable in 1918, $20,711,000, an increase of $5,795,000, or 38.9 per cent.

During the year $94,071,000 was applied out of revenue to current maintenance and depreciation, an increase of $9,515,000 as compared with 1916. Current maintenance increased $6,227,000, averaging 4.3 per cent on the average plant in service, which compares with 3.9 per cent in 1916.

The provision for depreciation of plant during the year was $52,919,000, an average of 5.5 per cent of the cost of plant, an increase over 1916 of $3,288,000.

Mr. Vail says that during the year there was a very general readjustment of salaries and increase in the number of operators to meet the necessary demands.

Regarding the value of the property, A. K. Vail reassures security holders by stating: "The minimum replacement value of our property, exclusive of intangibles, is far in excess of the book value, and intangibles represent expenditure and have value. Actual appraisals are continually being made by boards of control, municipal and other rate-making bodies for rate-fixing purposes. They are made by independent appraisers who certainly have no interest in over-valuation. In every case the appraisals have demonstrated the conservatism of the book value."

At the end of the year the number of employees on leave of absence for military, naval and other government war service was 7002.

Summary of Activities for Government

In a summary of activities of the system in connection with government matters, Mr. Vail says in part:

Precedence was established throughout the system for all government service, and at Washington and over the entire country for the maintenance of existing government facilities and the construction of the numerous additional ones required.

In other sections it has been necessary to provide telephone facilities and toll connections for the National Army cantonments, National Guard camps, division headquarters of the army and navy, army posts, navy yards, aviation fields, supply, quartermasters' and training camps, munition manufactures, shipbuilding yards, and various federal and state camps and headquarters in different parts of the country. Many of them are far from existing facilities and in sections heretofore not requiring extensive telephone facilities, and some of them are the equivalent telephonically of cities of 30,000 to 40,000 inhabitants.

Several pages in the report deal with the engineering department. Part of this section follows:

During the past ten years there has been a great increase in the number, extent, voltage and current of power and lighting circuits in all parts of the country. Therefore telephone engineers have been confronted by the difficult and constantly growing problems of disturbances in neighboring telephone circuits producing noise, interference with signaling and, in extreme cases, hazard. The electrification of trunk-line railroads, which has been largely a development of the last ten years, has brought up peculiarly difficult problems of this kind. Plans have been worked out as far as practicable for minimizing such disturbances by rearrangements of our wires and modifications in the apparatus associated with them. But in many cases the disturbances have been such that a solution was not to be found by treating only the telephone system. It has been necessary, therefore, to work with many electric light, power and railway interests and manufacturers of electrical power apparatus, and to arrange with them to design and operate their systems so as to reduce the disturbances at the source.

On Jan. 1, 1918, there was one Bell telephone station to each ten of the total population of the United States.

A section of the report dealing with the Western Electric Company, Inc., says in part:

When it became probable that this country would become involved in the great war, the Bell system, in preparation for extraordinary service demands which would come in such a contingency, directly and indirectly, from the various departments of the government, commenced a systematic restraint of station growth. That naturally affected adversely a certain portion of the Western Electric business. Later (in July) it appeared to us that we should do our part to conserve the resources of the country which would be required for war purposes, and we decided to limit construction and reconstruction which would use lead, copper and other materials, and likewise man power, to such work as would further military preparations. This cut down materially another part of the Western Electric product.

With this came the setting aside of its program on central office work and a substitution in its place of emergency requirements for camps, cantonments, etc., so that during the past year the company has been meeting a variety of changes in its requirements which will probably affect its earnings.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Northern California Power Company Elects Officers.—All retiring directors of the Northern California Power Company were re-elected at the annual meeting held recently, W. F. Detert remaining as president, A. S. Carman as vice-president and F. Reese, Jr., as second vice-president. Edward Whaley, former secretary and general manager, was made general manager, and W. H. Pearce, formerly assistant secretary, was elected secretary.

Violators of Light Regulations Considered Slackers.—Secretary H. G. Wilson of the Lucas County (Ohio) Fuel Administration states that violators of the regulations requiring lightless Sunday and Thursday nights and those who keep signs lighted at times not permitted will be branded as slackers and their names will be published as such. Energy was withdrawn from twelve signs in Toledo whose owners had kept them lighted on one recent evening, and it is proposed to continue the campaign against such persons.

Community Facilities in Housing Bill.—The committee on public buildings and grounds has favorably reported to the House of Representatives a bill authorizing the expenditure of $50,000,000 through the Secretary of Labor for housing local transportation and other community facilities for war needs. This is an administration measure and is likely to be enacted. The report on the bill calls attention to the fact that it "gives to the Secretary of Labor the power to acquire by purchase or otherwise such local transportation and other community facilities, or parts thereof, and equipment as in his judgment may become necessary for the proper execution of the trust created."

Ohio Commission Authorizes Utility Merger.—The Ohio Public Utilities Commission has authorized a merger of four public utility companies operating in Mansfield and the surrounding territory. The companies coming under the merger are the Mansfield Railway, Light & Power Company, the Mansfield Gas Light Company, the Mansfield Electric Light & Power Company and the Ashland Gas & Electric Company. The name of the merged company will be the Richland Public Service Company, and while it will control all of the above-mentioned properties, the Ashland Gas & Electric Company will be operated separately. The Richland Public Service Company is controlled by H. L. Doherty & Company, New York. The commission also authorized the issuance of $2,942,000 5 per cent bonds, to be marketed at 80. It further authorized the issuance of $3,200,000 common stock, which will be placed at 70. Both the bonds and the stock will probably be taken by H. L. Doherty & Company. R. E. Burger will continue as general manager of the Richland Public Service Company.

Relieving Coal Shortage.—A statement has been made by the Commissioner of Agriculture of Montana in regard to the use of electric power by the Chicago, Milwaukee & St. Paul Railway, which awarded recently a contract to the Westinghouse Electric & Manufacturing Company for ten electric locomotives. The railroad is now obtaining 160,000 kw. of electric energy from the hydraulic plant of the Montana Power Company and the saving in fuel effected by this use of water power instead of coal has been very gratifying to the State officials. The commissioner states: "To give an idea of the value of the power which is being generated by these plants it may be stated that to produce 160,000 kw. from coal would require the yearly consumption of 2,500,000 tons, which at the average price of $4, which would apply at the points where the power is used, would amount to $10,000,000. When it is considered that the value of this coal is by means of water power being saved each year for future generations, and that during the next ten years this saving will, in all probability, be increased seven or eight times, it is not difficult to understand that true conservation consists in encouraging the rapid development of water power, which unless developed and utilized becomes lost for all time."

Construction to Get Gas Fuel in California.—A. Emory Wishon, assistant general manager San Joaquin Light & Power Corporation, Fresno, Cal., writes to the ELECTRICAL WORLD in answer to an inquiry about its new pipe line: "In the past the San Joaquin Light & Power Corporation has used as fuel for electric generation a certain amount of gas in Bakersfield that has been obtained from the Valley Natural Gas Company. The capacity of the Valley Natural Gas Company's line has been used up, however, in supplying gas for domestic and other consumption, with the result that during the year 1917 practically no gas was used for steam generation in the Bakersfield steam plant. At present the San Joaquin has on order 26.5 miles of 6-in. pipe that is to be delivered in April and May and will connect the Bakersfield steam plant with the main gas transmission line of the Midway Gas Company, 26.5 miles due south of the city of Bakersfield. Last year the Bakersfield steam plant could have used 600,000,000 cu. ft. of gas. This year, unless the wet season starts pretty promptly, we shall use several times as much. The pipe line is to be a welded line and is capable of carrying sufficient gas to allow us to carry a peak of 10,000 kw. without calling on our oil reserve for peak operation. The San Joaquin also has a steam plant at Betteravia, Cal., that is connected to the Santa Maria oil fields with a gas line, and gas at this plant is being made available just as fast as we can deliver electric motors to replace crude boiler plants now operating the oil wells."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month on the next-to-last text page.

Louisiana Engineering Society. — A. M. Lockett presented a paper entitled "The New Orleans Industrial Canal" before the Louisiana Engineering Society on March 11.

New York Jovian League.—Richard E. Enright, Police Commissioner of New York City, told the story of the New York Police Department at the Jovian luncheon held March 13.

Synchronous Club, Los Angeles. — Lecture No. 10 of the Synchronous electrical course, on "Electric Furnaces and Welding," was given March 7 by J. H. Cunningham of the General Electric Company.

Electrolysis Mitigation. — James A. McKenna of the Providence city engineer's department addressed a meeting of the Providence Engineering Society recently on the subject of "Electrolysis Mitigation."

Arkansas Association of Public Utility Operators.—The State convention of the Arkansas Association of Public Utility Operators will be held at Hot Springs, Ark., on May 21 to 23, with headquarters established at the Arlington Hotel.

Jovian Electric League, Los Angeles. —At the last regular meeting of the league the speaker of the day was August F. Knudsen. The subject of his talk was "Hawaii." T. C. Carr of the General Electric Company was chairman of the day.

The Esthetics of Street Lighting.— S. E. Doane, chief engineer National Lamp Works of the General Electric Company, presented a paper on "The Esthetics of Street Lighting" before the Philadelphia Section of the Illuminating Engineering Society at a meeting on March 15.

New York Chapter, A. A. E.—E. W. McKnight of the First Canadian Expeditionary Forces spoke on "War-Time Experiences" at a meeting of the New York Chapter of the American Association of Engineers on March 13. I. L. Birner, 220 West Forty-second Street, is the secretary of the New York Chapter, A. A. E.

Gear Makers to Meet.—"Gear Standardization" will be the principal subject of discussion at the second annual convention of the American Gear Manufacturers' Association, to be held at Green Brier Hotel, White Sulphur Springs, W. Va., on April 18, 19 and 20. An address by a representative of the United States Chamber of Commerce, of which the association has just become a member, will bring other matters of timely interest before the association.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Refusal to Give Service.—In a decision regarding discontinuance of electric service affecting Max Huhn as complainant and the Richmond Light & Railroad Company as defendant, the New York Public Service Commission, First District, holds that refusal of service by an electrical corporation except upon the payment of a penalty because the service connection has been tampered with is unauthorized under the law; but in view of the fact that complainant may obtain redress by a penalty action under the transportation corporations law and because of the uncertainty as to the commission's power herein, no order was adopted. It was recommended, however, that upon payment by the complainant of $1.80 for each of the three months during which the meter failed to register service be renewed by the electric company.

Provision for Increasing Service Demands.—Approving plans of the Public Service Company of Northern Illinois for extension, the Illinois Public Utilities Commission declares that it has jurisdiction to enter an order finding the necessity for, and authorizing and directing the construction of, additions, extensions, repairs or improvements to, or changes in, the existing plant, equipment, apparatus, facilities or other physical property of any public utility, if the facts and conditions warrant, irrespective of whether or not property owners are made defendants to the proceeding, or make objections to such extensions or other changes. "It appeared from the evidence," says the commission, "that at the present time the Waukegan plant is normally capable of generating about 8000 kw. of electrical energy and at times has been overloaded to 9000 kw.; that, because of the excessive demands upon said plant and the increasing growth of petitioner's business and of the load carried by said plant, in order to meet properly the demands of the public it is necessary to install without delay in said plant an additional unit of not less than 10,000 kw., and that within four or five years it will, judging from the present rapid rate of growth of petitioner's business, be necessary to install a second additional unit of 10,000 kw. It further appeared that good operating practice, in case of an electric generating plant of this kind, requires that the plant have, adjacent to it, coal-yard storage capacity for at least sixty days' supply of coal; that such a supply of coal is, in good engineering and operating practice, considered the minimum coal supply which such a public utility plant should have on hand at all times in order properly to protect the public from interruption of service by reason of coal shortage, which is likely to, and very often does, occur as the result of one or more of the following causes: Labor difficulties at the mines, congestion of traffic on the railroads, car shortage, or unfavorable weather conditions interfering with transportation. It further appeared that in order to accommodate such a coal supply and to make a proper railroad track layout to handle such a coal supply, and to insure the continuous and proper operation and maintenance of the enlarged generating station it will be necessary to acquire, and petitioner has sought but without success to pnrchase, the property adjacent to its present plant hereinafter specifically described."

"When Costs Go Up Rates Should Do Likewise."—In allowing increased electric railways to the Portland Railway, Light & Power Company, the Oregon Public Service Commission made a number of statements touching utilities in general. Some of these are mentioned briefly below: "It is time for the public to realize that the powers conferred upon public service commissions, thoroughly tested and upheld by the courts, are ample for the protection of the public against all the evils from which they have suffered in the past. It is time also to realize that good service can be obtained only by just and equitable treatment. No starved horse ever pulled a heavy load. The utilities have been deprived of the power to make unjust profits. They must also be protected against unjust losses. . . . In spite of all that has been said, there still lingers a popular impression that the difficulties of the street railway company are fictitious and are merely used as a cover for an attempt to extort a profit on watered stock. We therefore wish to repeat with the utmost emphasis that if the stocks and bonds of the company were one hundred times the real value it would have no effect on this case. The appeal of the applicant and the decision of this commission are based on the commission's own valuation of the property. . . . The cost of service would not be less if the city should take over the street-car system and operate it. With the present service and equal efficiency of management, the operating expenses would be the same as at present, while power, instead of being furnished as now at cost, would have to be paid for at commercial rates. Under condemnation, it is not likely that the property could be bought for any less than the commission's valuation, and if the courts took account of the present scale of prices of materials and labor, the cost would be increased at least 25 per cent. . . . Under state regulation of rates no utility is permitted to earn a surplus during good times by which to carry itself over the lean years which may lie ahead of it. Rates must at all times be kept down in conformity with the value and the cost of the service rendered. Justice, therefore, requires that when costs go up rates for service should do likewise."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Notice of Line Defect.—In action for death of child from contact with a wire of a fence electrified by defendant's live wire, which had fallen upon it, it was held in Drimel versus Union Power Company (165 N.W. 1058) that whether defendant was negligent in failing sooner to find break and repair it was a question for the jury.

Anticipation of Danger from Wires Thrown Across Lines.—The Supreme Court of Kansas in Storm versus Leavenworth Light, Heat & Power Company (169 P. 556) followed the decision in Snyder versus Light Company (98 Kan. 157; 157 P. 442) in holding that a company should by maintaining sufficient insulation provide against dangers from a loose wire being thrown across its lines.

Electricity Deposit Does Not Apply to Gas Bills.—Where a consumer contracted separately for electric energy for lighting and for gas for heating with the same company, depositing $20 on the electric light contract, the company was not required to apply the deposit to the consumer's arrears on his gas bill before shutting off his supply, the company having no right to divert the deposit without the consumer's consent and apply it to an indebtedness accruing under a contract for gas made some months later than the contract for energy, the Court of Appeals of Maryland held (102 A. 465), Annapolis Public Utilities Company versus Martin.

Height of Wires.—While telegraph and telephone wires crossing a highway must be high enough for the usual and ordinary travel, they need not be high enough for extraordinary travel, in which case the traveler must keep a lookout, the Supreme Court of Iowa held (165 N. W. 449). The law authorizes telephone companies to construct their lines along the highways, but one section declares that the line shall not be constructed so as to incommode the public. The owner of a telephone line strung along a country highway constructed the line at a sufficient height at the ordinary points of ingress and egress to clear ordinary vehicles. It was held that, as a landowner is not entitled as against the public to access to his land at all points along the boundary between it and the highway, an abutting landowner could not require the owner of the telephone line to maintain it at a height along the entire boundary of his property sufficient to permit an unobstructed passageway from the highway into his fields, and hence could not assume in passing out of the field into the highway at a place not ordinarily used that the line was high enough to clear his vehicle.

George Oates has resigned from the district managership of the Utah Power & Light Company at Rexburg, Idaho.

Charles B. Hill, Buffalo, N. Y., has been appointed chairman of the Public Service Commission for the Second District.

Carl A. Wolfrom has been promoted from assisting operating manager to district manager for the Utah Power & Light Company at Rexburg, Idaho.

C. I. Weaver of Jackson, Mich., has been appointed general manager of the Springfield (Ohio) Light, Heat & Power Company, to succeed Weare Parsons.

E. E. Sanford of the Northern States Power Company of St. Paul, Minn., has been elected a director of the local Y. M. C. A. for the next three years.

George W. Smidt, power-station engineer for the Dubuque (Iowa) Electric Company, has been appointed to a similar position with the Northern Ohio Traction & Light Company, Akron, Ohio.

C. B. Hudson, formerly superintendent of the power plant of the Ithaca (N. Y.) Traction Corporation, has been placed in charge of the power plant of the Strathmore Paper Company, Woronoco, Mass.

Major Peter Junkersfield, assistant to the vice-president of the Commonwealth Edison Company, Chicago, and who was in charge of the electrical construction of the cantonments, has been advanced to the rank of lieutenant-colonel.

Joseph Bamberger, who has been connected with the Northern Indiana Gas & Electric Company, Lafayette, Ind., for the last ten years, has been appointed assistant engineer of the Wabash Valley Electric Company of Clinton, Ind.

F. C. Adams, St. Louis, Mo., has been chosen chairman of the committee representing the electrical interests of that city on the board of a permanent organization which has been formed to urge the advantages that St. Louis possesses as a center for the manufacture of construction materials for the government.

J. L. Kent, formerly with the Consumers' Power Company, Grand Rapids, Mich., has been appointed commercial manager of the Springfield (Ohio) Light, Heat & Power Company, succeeding **J. E. North,** resigned. Mr. Kent is a graduate of the Ferris Institute and has been connected with the Hodenpyl-Hardy interests for about nine years.

A. N. Richardson, who has been connected with the Union Electric Light & Power Company during the past year in construction work, has been appointed operating superintendent by the Illinois Northern Utilities Company, Dixon, Ill. Mr. Richardson was formerly general superintendent of the Kansas City Electric Light Company. Prior to that he was for a number of years connected with the Washtenaw Light & Power Company, later the Washtenaw division of the Eastern Michigan Edison Company.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

Francis A. Vaughn, senior member of the firms of Vaughn & Meyer, consulting engineers, Milwaukee, and Charles L. Pillsbury Company, consulting engineers, Minneapolis and St. Paul, has been engaged by the School of Engineering of Milwaukee as business manager and director of engineering and industrial relations. Mr. Vaughn is a graduate of the University of Wisconsin in electrical engineering, class of 1895. He was in the testing department of the Standard Telephone Manufacturing Company, later in the Gibbs Electric Company and then for fourteen years with the Milwaukee Electric Railway & Light Company in the operating, engineering, meter-testing and distributing departments. Mr. Vaughn has had a very intimate connection with national engineering societies and is a fellow of the A. I. E. E. He has been president of the Milwaukee Electrical League and trustee of the Engineering Society of Wisconsin, besides having been chairman of the Wisconsin Electrical Association committee on revision of the Wisconsin Railroad Commission's electric service rules.

F. A. VAUGHN

Joe E. King has been transferred from the post of local superintendent for the Southern Sierras Power Company at Corona, Cal., to a similar position at San Bernardino.

Robert C. Lamphier, secretary and general manager of the Sangamo Electric Company, Springfield, Ill., has been elected president of the Springfield Commercial Association to succeed John M. McCreery, manager of the St. Nicholas Hotel. Mr. Lamphier has been active in the Red Cross work in Springfield and has taken a prominent place in civic affairs.

Frank B. Jewett, chief engineer of the Western Electric Company, who received the commission of major last spring, has been promoted to the rank of lieutenant-colonel.

J. I. Matthias, manager of the Leominster (Mass.) Electric Light & Gas Company plants, has resigned to go into business for himself in Worcester. Mr. Matthias has recently been elected chairman of the mercantile bureau of the Chamber of Commerce of Worcester.

S. E. Hutton, for several years head of the mechanical and electrical engineering departments at the University of Idaho, recently enlisted in the United States Army, at Spokane, Wash., as a private in the aviation section of the Signal Corps. Mr. Hutton was formerly consulting engineer of the Idaho State Public Utilities Commission and on the faculties of Highland Park College at Des Moines, Iowa, and the University of Kansas.

James B. Black, formerly assistant general agent of the Great Western Power Company at San Francisco, has taken over the duties formerly discharged by W. W. Briggs, resigned, and has been given the title of general sales manager of the Great Western System. Three distinct systems are operated jointly in the Great Western System. These are the properties of the Great Western Power Company, the Great Western Power Company of California and the City Electric Company.

W. C. Austin, auditor of the Eastern Pennsylvania Railways Company, Pottsville, Pa., has been elected assistant secretary and assistant treasurer of that company. In 1917 Mr. Austin was transferred from the staff of traveling auditors of the J. G. White Management Corporation, New York, N. Y., to the accounting department of the Eastern Pennsylvania Railways Company, which company is being operated by the management corporation. For a number of years Mr. Austin was treasurer and auditor of the Otsego & Herkimer Railroad Company (now Southern New York Power & Railway Corporation), Cooperstown, N. Y.

Obituary

W. J. Macy, formerly secretary to the president of the Birmingham Railway, Light & Power Company, has died of pneumonia in France, where he was serving as a member of the motor-truck department of the quartermaster's service.

A. W. Sharp, Jr., of the Fort Wayne department of the General Electric Company, Chicago office, died, at the age of twenty-eight years, on March 4. Mr. Sharp was a graduate of Lewis Institute, Chicago, and immediately upon leaving school entered the Fort Wayne Electric Works. After that company was taken over by the General Electric Company in 1913 he was employed in the Fort Wayne department, specializing mainly on battery-charging apparatus.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

SUPPLY OF RAW MATERIAL NOW IN FAIR CONDITION

Current Needs Difficult to Satisfy—Anticipating Requirements the Only Solution—Shipments and Deliveries Vexing

Broadly speaking, manufacturers appear to be in a fairly satisfactory position respecting the supply of raw material. Interviews with leading concerns in the various branches of the trade confirm this impression. Moreover, there is no indication of uneasiness regarding future requirements, despite the governmental restrictions on certain metals and other basic material. Deliveries, of course, are the bane of the industry, so much so that they are mentioned as affecting the ultimate selling price of the finished product. On the matter of prices generally an authority said that the most important factor contributing to the increases are the intensification of demand for material, the disruption of distributing processes, a shortage of labor and the decrease in the production of various products. Manufacturers with expanding programs are obliged to buy material when the opportunity presents itself for the certain delivery of the goods, preparing against periods when cars are unavailable for shipments. In other words, manufacturers have to stock requirements for future operations on a far greater scale than they would if they could depend on deliveries when the supplies are needed.

As one producer stated, the demand for raw material in the steel, iron and copper lines appears to have no limit. To be sure, it was explained, the situation is badly mixed, but the supply of metal and other material entering into the manufacture of machinery, generators, motors, transformers and apparatus of every description is easing up and deliveries are slightly better. Concerning wire and cables it was learned that copper seems to be plentiful for other than government work and can easily be had if the producers have it, and they are not yet being reported as short of the metal. Prices remain at the official standards. Shipments from the smelters can be made, but the embargoes hold up the deliveries. Unless priority orders, to which all shipments of this kind are subject, are obtained from the freight traffic committee by the consignee, the delay may be indefinite. Cotton and rubber, indispensable in the production of certain wire, cable and other electrical products, are practically in the same class as copper.

In other lines where not only copper is an essential but brass, slate, steel castings and sheets are basic materials a representative of one of the largest manufacturers in either East or West said that his company had anticipated its requirements for the last two years and was therefore fully provided to meet every demand. In the fall of 1915 this concern carefully went over its inventories for the preceding year, and it based its requirements for 1916 on the aggregate plus 100 per cent. It was figured that this would represent the probable increase in the business, and material was placed on order on this basis. Of this stock of raw material 92 per cent was worked up into its finished products, representing only 8 per cent of overbuying. For 1917 the same plan was adopted, with a still further increase of 30 to 35 per cent, which will carry the plant up to September of this year.

By placing its orders far in advance this manufacturer—and there appear to be others following the same plan—provided against future inconvenience or shortage of material. The first question to be considered is the one of delivery, with price secondary, a rule which seems to prevail in every transaction. According to this concern, no contracts on copper can be made for future requirements. It is bought at the market—base price plus the cost of rolling or drawing. In order to be sure of a shipment of copper a manufacturer had three cars of the metal forwarded by express from Connecticut to a Western city at a cost of $6,000. The company in question, like three-fourths or more of the manufacturers, has government contracts, and therefore shipments of either raw material or the finished goods are granted the advantages of priority certificates, otherwise the embargoes interfere with deliveries to the regular trade.

An advance in steel castings is considered a probability by a number of manufacturers, although it is intimated that the official price, which remains in force until March 31, will remain at the present figure. The American Iron and Steel Institute, acting in conjunction with the War Industries Board on this question, declines to state its position one way or the other. As regards gears and pinions, a manufacturer of prominence said, shipments have been held up since Jan. 1, which has resulted in the delivery of only a quarter of the quantity usually sent out. All export business has been suspended for the time being. While government control is not affecting gear steel, forged gear blanks are almost impossible to obtain on reasonable delivery. Pinion material is costing more than ever before, but prices have not advanced recently. Malleable iron is easier. In plants of this description and those on parallel lines in the electrical field labor is the most trying problem. Skilled workmen are required, and they are scarce and of uncertain tenure on account of the abnormal wages.

Quotations on nearly if not quite all raw material for electrical goods are made f.o.b. plant, with shipment at convenience of mill or factory. As one of several manufacturers who volunteered the information said, shipments in the immediate neighborhood can be accomplished, but to reach points in the Middle West with either material or finished goods is difficult, often taking two or three months.

CO-OPERATIVE BUYING BY CENTRAL STATIONS

Inexpensive Portable Lamp of Standardized Design Is Produced as the Result of Conference

Thirty thousand portable lamps of a standardized design are to be placed on the market next fall as the result of a recent conference in New England between a group of central-station men and a fixture manufacturer who is handling this order on an off-season basis. This co-operative buying plan includes central stations from some of the largest cities in the country, whose representatives met informally to develop the program of securing a fixture at low cost for multiple production and wide distribution. The movement promises far-reaching results in the large-scale merchandising of electrical appliances. Those behind the plan believe that individualism has been overplayed in many lines of electrical selling to the general public; they believe that certain standardizations of design can be accomplished to appeal to a very wide market, and that through the concentration of orders and through intensive production along repetitive lines costs can be lowered to a point which will mark a new stage in the popularization of electrical merchandise.

When these central-station men assembled they met at a Connecticut fixture factory where an enormous yearly output of kerosene lamps of a simple design is produced for the Chinese trade. They recognized, of course, that no standard design of portable lamp will suit the entire market, but they believe that a large buying power exists among the public for a low-cost standard product of general

application. It is believed that a great many persons will be glad to purchase a portable lamp of uniform design, wholly regardless of the fact that other people may be using the same product, provided that the price is low enough.

The matter was discussed with the manufacturer, and a design of portable lamp has been prepared which is expected to meet an extremely wide range of service conditions, applicable to business and home surroundings. The central-station men present represented the sales departments of their several companies, and it is noteworthy that some of the smaller cities represented were among the heaviest underwriters of the plan.

Owing to its being the dull season in fixture production, it was possible for the manufacturer to take the order upon a very satisfactory basis of cost. The raw material for these lamps has been purchased on a more satisfactory basis of price and delivery than applies to small and individualistic orders for scattering shipment at odd times. The manufacturer has been enabled to plan his production for steady output during the off-season, and the various central stations will receive these lamps at a price which will enable them to market them at about the former factory cost level.

As a result of these negotiations and because of the optimism felt by the central stations concerned, a standardized desk lamp is now in process of development for handling in the same way. One of those attending the conference informed the representative of the ELECTRICAL WORLD that the co-operative purchasing plan will probably be extended into other lines of appliances and that the movement marks the beginning of what may prove to be a new era in electrical merchandising.

METAL MARKET SITUATION

Copper in Easy Supply, but Restrictions Are Imposed —Position of Platinum and Aluminum in Question

No trouble is being experienced in obtaining a sufficient supply of copper for "essential commercial purposes," but no commitments on the metal will be accepted by producers or jobbers on contract. The market is the base price, which is a shade lower this week, plus rolling or drawing, subject to the scrutiny of the copper committee in making the allotment of supplies.

One of the elements of interest in the metal market is the position of platinum, now under government control. Germany is now reported to have purchased the entire available supply of platinum in Russia, the world's principal platinum market, and to have made this purchase at her own figure.

Buyers and sellers of aluminum are awaiting the government ruling in transactions on the 32-cent base price at shipping point in lots of 50 tons and over.

Old metals remain at practically the same prices that have been quoted for several weeks, and no unusual demand for them is reported in existence at this time.

NEW YORK METAL MARKET PRICES

	March 4	March 11
Copper:	£ s d	£ s d
London, standard spot	110 0 0	110 0 0
Prime Lake	Govt. price 23.50	Govt. price 23.50
Electrolytic	Govt. price 23.50	Govt. price 23.50
Casting	Govt. price 23.50	Govt. price 23.50
Wire base	*27.00	26.25 to 26.75
Lead, trust price	7.25	7.25
Nickel, ingot	50.00	50.00
Sheet zinc, f.o.b. smelter	†15.00	†15.00
Spelter, spot	7.77½ to 7.82½	7.67½ to 7.72½
Tin, Straits	*85.00	*85.00
Aluminum, 98 to 99 per cent.	†Govt. price 32.00	†Govt. price 32.00

OLD METALS

Heavy copper and wire	21.50 to 22.00	21.50 to 22.00
Brass, heavy	14.00 to 15.25	14.00 to 15.25
Brass, light	10.00 to 10.50	10.00 to 11.00
Lead, heavy	6.25 to 6.50	6.25 to 6.50
Zinc, old scrap	5.50 to 5.75	5.50 to 5.75

*Nominal. †F.o.b. producer's plants.

THE WEEK
IN TRADE

JUDGING from the reports received from the cardinal points of the country, electrical business is in excellent shape. An official deliverance that the sale of electrical merchandise was running behind last year's record appears to have been made without the facts. At any rate, the buying of large equipment by shipbuilders and the government continues apace. The aggregate is on an enormous scale; in fact, it dominates the industry.

Freight congestions and troublesome deliveries are more acute than ever in all parts of the country. Some price changes have occurred. On the part of the regular trade there is a steady and increasing demand for staples. In some instances jobbers are having all they can handle in the way of business.

Financially the trade appears to be on a sound basis, with collections from tight to easy. Credit lines have narrowed, ironclad provisions are inserted in contracts, and payment terms are shortened.

NEW YORK

Very little complaint is heard concerning the general average of business in all electrical lines. Occasionally a pessimist is encountered whose selling methods may be responsible for his hypercritical attitude. The large majority of jobbers, distributers and dealers, as well as manufacturers, report an active demand for electrical staples and specialties. The volume of trade is greatly in excess of the same period last year. With a shortage in certain lines a demand for second-hand equipment is in evidence, and this class of goods is said to be moving out as rapidly as acquired. Some changes in prices have occurred, but no recessions are recorded. Shipments and deliveries which are still restrictive, are troublesome factors and will probably not be wholly eliminated under current conditions.

Differences exist respecting financial obligations, but collections, on the whole, are fairly prompt. Credits receive close attention, and trade acceptances are being strongly urged by jobbers as the best solution in the sale of merchandise as against open-book accounts.

FUSES.—An active market is the majority opinion of distributers and jobbers, with dealers keeping representative stocks and reporting a brisk movement.

LAMPS.—The situation is very much improved with the elimination of the slow sellers and the distribution of stocks on a more equitable basis. An ample supply is reported with the exception of some standard sizes, which are being taken over by the government in large quantities.

PANEL SLATE.—An advance of from 20 to 25 per cent was made within a few weeks. The best grades, free from flaws or metallic veins, are none too plentiful. The difficulty of retaining labor at the quarries is also adding to the cost, as well as deliveries, which are not infrequently made by express. The express carriers are becoming more exacting in their acceptance of shipments, and this is becoming likewise bothersome.

HEATING APPLIANCES.—Trade of a very satisfactory nature is a current condition in every branch of the business. Jobbers and dealers are also stocking up on a generous basis with the regular lines of household appliances, including washing and sewing machines, flatirons, toasters, percolators and chafiing dishes, in anticipation of heavy sales during the warm weather.

PORCELAIN.—The market is short in all goods of this kind, and stocks in the hands of distributers, jobbers and retailers generally are low. This is to be accounted for by the extraordinary buying for government needs. It is believed that the situation will not ease off appreciably until these requirements are satisfied.

COLLECTIONS AND CREDITS.—A few reports are to the effect that collections are falling behind, but the greater number bear a favorable aspect. It appears that when financial obligations receive unremitting care the results are proportionate to the effort. The lack of building operations and erratic deliveries of goods are cited as primary causes for the slowing up of payments by contractor-dealers. Credits have not eased off so far as can be noticed.

SOCKETS.—Every variety of the line is spoken of as in steady sale, with no complaint of a present or anticipated shortage.

CONDUIT.—Prices have receded about 5½ per cent—4 points. On all sizes this staple is extremely short in supply. A few jobbers who are yet receiving shipments under old contracts—which are being carried out by the producers most reluctantly, reports say, on account of the price—have a small stock. This is tenaciously reserved for the highest selling figure obtainable. Delivery is the primary consideration, with price a secondary matter.

DRY BATTERIES.—No advance has been made in several months, despite statements to the contrary. Fair stocks in the hands of primary distributers and manufacturers are reported.

CHICAGO

The tone everywhere in the trade during the last week has been more optimistic. The fact that more sales were made in February than in January and increased activity that comes with spring in part are responsible for the general tone. Central stations are not buying much, but the retail trade is better. Moreover, the conditions seem to be improving even in the building field. The record of building permits and electrical permits, which had reached a very low mark early in 1918, is now climbing slowly but steadily.

In the week ended March 6 permits aggregating $422,800 were issued. In the previous week there were thirty-four permits aggregating $505,800, and in the same week last year there were 139 permits, aggregating $1,281,850. In the week ended March 6 558 electrical permits were issued, totaling 5961 incandescent lamps and 578 hp. in motors. In the week previous there were 452 permits, aggregating 5794 lamps and 469 hp. in motors. In the same week in 1917 there were 781 electrical permits.

HEATING APPLIANCES.—Shipments of hollow ware from the East that have been en route for five weeks have not yet arrived in Chicago.

CONDUIT.—The delivery situation is improving. It is now possible to get shipments through on priority orders in fairly good time, whereas it formerly seemed impossible to get shipments on any kind of an order. The price of conduit has taken a four-point drop, which amounts to about 5 per cent. This was done to put the finished-product price more nearly in line with the government's fixed price on raw material. The price change is said to have no relation whatever to conditions of supply and demand in the market.

LAMPS.—Demand is strong and steady. Deliveries are getting better.

ELECTRIC TRUCKS.—Thirty-five trucks have been sold in Chicago in the last winter. Prospects for more sales this spring are bright.

FLOODLAMPS.—Business, which was stimulated to an unexpected degree by plants with war orders, has continued unabated. It is now characterized as "better than ever."

FARM LIGHTING SETS.—Business is improving steadily and at a fairly rapid pace, although there can hardly be said to be a boom in progress. There is an increasing tendency to distribute these goods through the electrical trade.

INCANDESCENT LAMPS.—A one-year contract to provide electric bulbs to all Indiana State institutions has been let to the Indianapolis Belting & Supply Company. To the same company was awarded a contract to provide other electric lighting supplies. The contract for electric bulbs provides that $10,000 worth shall be used in a year.

BOSTON

War industry dominates the electrical trade as the spring approaches. The volume of business continues very heavy. Prices show little change, barring an advance of $5 in electric valve grinders scheduled for last Monday. Central stations with few exceptions are maintaining an extraordinarily conservative policy regarding new work, but the easing of the fuel situation and restoration of normal lighting five nights a week are stimulating earnings and to some extent will be reflected in the future sales of supplies. Collections are tight, for the most part. Trade acceptances are coming into more general use in jobbing circles.

It is announced that the government will expend a total of about $18,000,000 on the great army base to be built at Boston for transatlantic forwarding. Jobbers expect to obtain heavy orders of equipment and supplies in connection with this terminal. The large army and naval stations continue substantial buyers of supplies. Military and naval hospitals are buying electric centrifuges in quite large volume. It seems impossible to get any one to say a good word for the railroad service, deliveries showing little if any improvement as yet. A decided boom in the sale of electric road trucks is noted in the Boston district. Labor is quiet.

MOTOR-DRIVEN VALVE GRINDERS.—These are in great demand, and factory stocks are reported to be low. An advance in price from $30 to $35 was scheduled for Monday in the case of the Stenman electric valve grinder made at Worcester, Mass.

IGNITION BATTERIES.—Stocks are in good shape. One dealer has just received two carloads of batteries, and the outlook is excellent for spring business.

ELECTRIC TRUCKS.—A decided increase in the demand at Boston is noted for electric road trucks. One dealer has sold sixty-eight trucks in the last three months. Deliveries are being made in one to two weeks.

INDUSTRIAL ELECTRIC TRUCKS.—Inquiries are increasing. The government was reported to be in the market for forty-eight units at the end of last week. Prices remain steady and deliveries fair.

ELECTRIC PASSENGER CARS.—Interest is increasing and is reflected in good sales. A prominent dealer sold all the cars he exhibited last week at the Automobile Show.

LAMPS.—Consumption is increasing, with the abandonment of lightless nights. Production is in good volume and railroad delays are the chief obstacle to local stock building.

WIRE AND CABLE.—Government orders in heavy volume predominate, with firm prices and poor delivery conditions due to railroad difficulties.

FIBER CONDUIT.—Although business is quiet and inquiries have not matured to any great extent, one large central-station order covering the year's requirements has been booked by a Boston agency, following a proposition by the latter to carry the completed product at the factory pending service demands. Prices are steady and deliveries can be made along satisfactory lines.

ASBESTOS INSULATION.—Business is very active, with no change in prices. It is difficult to accumulate factory stocks at present.

ELECTRIC RADIATORS.—Jobbers report a remarkably good season, which is still continued. One wholesaler has distributed 6500 radiators of a single make since Jan. 1, and looks for an attractive business in connection with summer cottages and camps this year.

MOTORS.—A heavy demand is noted for sizes of 10 hp. upward, with fair deliveries. A representative quotation is from two to three months on standard types of alternating-current and direct-current motors, four months being promised on special equipment. Government orders are well maintained and constitute the backbone of the motor business to-day.

CONDUIT.—Spasmodic deliveries continue to disturb the market. Jobbers appear to be well stocked in smaller sizes, and here and there larger diameters are in the bins. Last week's four-point drop in price means little to New England under existing delivery conditions. Some goods ordered a year ago are still to be received.

ATLANTA

As a rule reports agree that trade in general is running well ahead of the same period last year. Whether the increase is based on monetary value or volume is debatable, but opinion appears to favor actual gains in physical volume as accountable for the excess. The congestion in transportation has measurably subsided, and shipments from points west of Pittsburgh consigned south are moving freely; but, on the other hand, freight movements from Eastern points to this section are very slow. The aggregate value of building permits for February was greater than for any month since last September. Industrial construction continues to expand, with a large volume under way. The Saxon and Spartan Mills, Spartanburg, S. C., have closed contracts for approximately $110,000 worth of electrical equipment. Individual motor drive will be used practically throughout both mills. Energy will be secured from the Blue Ridge Power Company, Spartanburg, an affiliated corporation.

STREET LIGHTING.—There is no noticeable activity in new equipment, but jobbers state that a number of municipalities are buying freely of replacement material, such as reflectors and miscellaneous goods, to handle much-needed repairs. Deliveries on all classes of this material are good, and jobbers experience no difficulty in taking care of the volume of business from local stocks.

FANS.—Jobbers report a substantial number of inquiries for early delivery. Some sales have been made on the basis of 15 to 25 per cent above 1917 prices.

ATTACHMENT PLUGS.—While the call for these has been good, the demand has been further stimulated by anticipated fan business. Local stocks are in good shape.

DRY BATTERIES.—The demand has been phenomenal and it is merely a question of having them on hand for delivery. Shipments to this section have been spotty, but on the whole carload-lot deliveries are pretty fair considering the Eastern freight congestion.

FLASHLAMPS.—Demand is very steady, with about the same volume of sales as registered during the last six months. Batteries and casings for the dollar and two-dollar sizes are very hard to get, and stocks are low.

PIPE FITTINGS.—This line follows closely the call for steel products, which has been strong. A slight improvement is noted in deliveries.

PORCELAIN PRODUCTS.—There is no cessation in the demand for knobs, cleats and tubes. Local stocks are pretty well cleaned out, and replacement orders are not coming in

SOCKETS.—Stocks are very low, and more or less trouble is experienced by the jobbers in handling the large demand.

LAMPS.—There appears to be no let-up in the volume of business being done. All standard sizes are popular. Stocks are holding up well under the pressure, and deliveries are prompt. There is no evidence at this time of the shortage which was predicted some time back.

SEATTLE

The usual heavy volume of sales to shipyards and industrial plants was maintained during the week. There is considerable big business in prospect. The contract will be let shortly for the power apparatus for a new shipbuilding plant to be among the largest in the Northwest. Several new plants will soon let contracts for the larger sizes of wire and cable. As regards inquiries and prospective business, last week exceeded the record for several months. Stocks of sewing and washing machines are running low but heavy shipments are en route. Sales of these and other domestic appliances are maintaining the levels of several weeks past.

The condition of car shortage is reported equal in seriousness to that of the fall of 1916. The shingle-mill owners in the West coast territory have voluntarily brought the industry under an eight-hour day, as have the lumber mills in the Western Pine Association in eastern Washington and Idaho.

Bulk handling of wheat is gaining in favor to such an extent that the authorities state that more than 200 grain elevators will be erected in the Northwest this year. One Portland firm alone has a contract for twenty-five, ranging in price from $25,000 to $35,000 each. Electrical jobbers in the Portland and Spokane fields particularly report increasing inquiries and orders for both large and small motors and lighting equipment for elevators under construction. Thirty thousand acres of land will be devoted to the sugar-beet industry in Yakima County, Washington, this year, instead of 10,000 as last year.

Seattle faces spring with its available supply of rented houses exhausted. The problem of housing Eastern mechanics and families employed in the shipyards is serious. New residence building continues increasing. Tacoma shipyards plan asking the government for $1,500,000 to meet the housing problem. The principal activity in building lines in the Northwest cities is in residences, and this, in Sound cities especially, is heavy.

Retailers report that the lighting fixture business is daily increasing as the result of residence building and remodeling. In new residences fixtures are not installed until the houses are sold, builders leaving the selection of the class to the option of the purchaser. Sales of drop cords, switches and buzzers are heavy, and March business is expected to be exceptionally heavy. Floodlamps are selling as fast as they can be obtained. Portland and Gray's Harbor fields are buying heavily. Stocks are low, but it is believed will be in good shape in three weeks with shipments en route.

SAN FRANCISCO

The past week has been unmarked by any striking developments. Jobbers report the arrival of several long-expected carloads, covering such necessities as rubber-covered wire and schedule material and such articles of popular demand as sewing machines and washing machines. The rainfall continues, guaranteeing a very prosperous year to the coast. Governmental and State contracts are helping to ballast building conditions. In the past week the government awarded two contracts, amounting to $1,000,000 each, for the construction of two aviation schools and camps, one to be built at Mills, near Folsom, Cal., and the other at Riverside, Cal. Buildings to house various war activities are to be erected by Red Cross chapters. The Rolph Shipbuilding Company at Eureka will erect the first unit of fifty community cottages for employees of its plant, and a number of fruit-drying stations, to accommodate a million-dollar contract from the government, will be built by E. C. Horst.

Oakland building permits for February were 172 in number and aggregated $408,000. San Francisco building permits were 340, to cost $538,000. Government work is censored and is not included in this report. The San Francisco comparative report for 1917 was $1,166,000. This is about the average decrease in private construction. Reports from southern California make light of the strike of electrical workers on the lines of the Southern California Edison Company.

MOTORS.—The demand for motors is good and well distributed. For small-size motors stocks and deliveries are excellent, the greatest demand being for pumping plant sizes of 1 hp. to 5 hp. inclusive. For larger sizes, 15 hp. and over, the demand exceeds the supply. Dealers in second-hand motors are doing a good business and find a market for every old motor that they can refurbish and put back.

FARM PLANTS.—The prosperity of farmers in general and the influence of several large advertising compaigns on farm plants are producing a good demand. Deliveries are poor. In the opinion of shrewd observers this demand will continue to increase, one decided factor being the influence of the automobile and the realization of farmers, through its use, that gasoline engines and storage batteries are not too technical and complicated to be handled by them.

INSULATING MATERIAL.—Deliveries, stocks and sales are all good, with the solitary exception of linen tape, which requires six months for shipment. The products of factories making this tape are absorbed by the Red Cross. The demand for second-hand motors, referred to above, is responsible for a big demand for insulating material to be used in repairing them, also for second-hand transformers. The shipbuilding industry requires a considerable amount of fiber to be used in pipe gaskets.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTORS, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List to $61.00
Coil to 1000 ft	10% to 59.17
	No. 12 Solid
Less than coil	List to $71.00
Coil to 1000 ft	—10% to 68.87

Twin-Conductor

	No. 14 Solid
Less than coil	List to $105.00
Coil to 1000 ft	$70.00 to 10%
	No. 12 Solid
Less than coil	List to $135
Coil to 1000 ft	10% to $130.95

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+ 15% to 20%
Coil to 1000 ft	5% to 20%
	No. 12 Solid
Less than coil	+ 15% to + 20%
Coil to 1000 ft	—10% to 20%

Twin-Conductor

	No. 14 Solid
Less than coil	15% to $115
Coil to 1000 ft	—20% to $80
	No. 12 Solid
Less than coil	+15% to + 20%
Coil to 1000 ft	—20% to 5%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10% to $24.00
1/5 to std. pkg	20% to 19.80
Std. pkg	34% to 18.75

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+ 20% to 12%
1/5 to std. pkg	20% to List
Std. pkg	28% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.28 to .285	.29 to .295

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.3175-.3195	.3215-.3295
Barrel lots	.2875-.2895	.2915-.2995

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List, Per 100 Ft.
5/16	250	$5.00
⅜	250	7.50
½	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less Than Coil	Coil to 1000 Ft.
⅜-in. s. stp.	Net to $75.00	—15% to $69.75
⅜-in. d. stp.	15% to 75.00	15% to 72.00
½-in. s. stp.	List to 100.00	—15% to 93.00
½-in. d. stp.	+15% to 100.00	List to 96.00

NET PER 1000 FT.—CHICAGO

	Less Than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.75
⅜-in. double strip	78.25-78.75	71.25-71.75
½-in. single strip	100.00	85.00
½-in. double strip	105.00	95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List Per Foot	Size, In.	List Per Foot
7/32	$0.05½	1	$0.25
¼	.06	1¼	.33
⅜	.09	1½	.40
½	.12	1¾	.47
⅝	.15	2	.55
¾	.18	2¼	.65

NET PER 1000 FT.—NEW YORK

Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in. $25.00-$55.00	$20.50-$24.50	$20.00-$21.50
¼-in.— $28.00-$60.00	$22.50-$27.00	$22.00-$23.50

NET PER 1000 FT.—CHICAGO

Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in. $36.00-$55.00	$25.00	$22.50
¼-in.— $40.00-$66.00	$27.00	$25.00

CONDUIT, COUPLINGS AND ELBOWS. RIGID IRON

Card No. 38

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37
2½	.58½
3	.76½

	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in
Less than 2500 lb.	4% to 10%	6% to 12%
2500 to 5000 lb.	7% to 9%	12% to 15%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ in. to ½ in.	¾ in. to 3 in
Less than 2500 lb.	1.3% to 4.7%	4.3% to 7.7%
2500-5000 lb.	3.3% to 6.7%	6.3% to 9.7%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.00
Discount	30%

CHICAGO

List	$5.00 to $6.00
Discount	25% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	28%
1/5 to std. pkg	38%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	28%
1/5 to std. pkg	38%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$5.00 to $5.75
1/5 to std. pkg.	4.50

Standard package, 500. List, each, $0.07.

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$6.25
1/5 to std. pkg.	5.25

Standard package, 500. List, each, $0.07.

LAMPS, MAZDA

105 to 125 Volts

Regular, clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.30
60-watt—B	100	.35
100-watt—B	24	.70
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round bulbs, 3½ in., frosted:		
15-watt—G 25	50	.53
25-watt—G 25	50	.55
40-watt—G 25	50	.55
Round bulbs, 3¾ in., frosted:		
60-watt—G 30	24	.77
Round bulbs, 4¾ in., frosted:		
100-watt—G 35	24	1.10

DISCOUNT—NEW YORK

Less than std. pkg.	Net
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	Net
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$24.90 to $31.00
Coil to 1000 ft.	22.72 to 27.90

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$29.00 to $30.00
Coil to 1000 ft.	21.50 to 33.50

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$20.00 to $29.00

CHICAGO

Net per 100	$19.17 to $24.00

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200 S.E., 300, AX, 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	25%-37%	20%-32%
$10.00 to $50.00 list	42%-45%	37%-40%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg	30%

PORCELAIN CLEATS—UNGLAZED

2 and 3 Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $38.00
1/5 to std. pkg.	19.00 to 20.00

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$15.80
1/5 to std. pkg.	14.80

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

Per 1000 Net	Std. Pkg. 3500 5½ N. C.—Solid Nail-it—N.C.	Std. Pkg. 4000
Less than 1/5 std. pkg.	$27.50 to $29.00	$30.75
1/5 to std. pkg.	15.60 to 20.75	24.20

CHICAGO

Per 1000 Net	Std. Pkg. 3500 5½ N. C.—Solid Nail-it—N.C.	Std. Pkg. 4000
Less than 1/5 std. pkg.	$11.85	$30.75
1/5 to std. pkg.	11.10 to 11.40	24.20

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push		
⅛-in. cap key and push sockets.	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net to $23.00
1/5 to std. pkg.	20% to 21.00

NET PER 100—CHICAGO

Less than 1/5 std. pkg.	24% to $25.00
1/5 std. pkg.	30% to 23.00

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	List to + 5%
$10 to $25 list	11%
$25 to $50 net	14% to 15%
	Low Grade
Less than $10 list	5% to 10%
$10 to $25 list	16%
$25 to $50 list	24% to 25%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+5%
$10 to $25 list	10% to 11%
$25 to $50 list	—14%
	Low Grade
Less than $10 list	5%
$10 to $25 list	—16%
$25 to $50 list	24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

SWITCHES, SNAP AND FLUSH—Cont'd

10-Amp. 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	List
1/5 to std. pkg.	15%
Std. pkg.	28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20% to list
1/5 to std. pkg.	List to —15%
Std. pkg.	30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List	Net
$2.00 to $10.00 list	10% to 20%	5%
$10.00 to $50.00 list	20% to 30%	15%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25%	15% to 20%
$2.00 to $10.00 list	25%	20%
$10.00 to $50.00 list	25% to 35%	20% to 25%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00
Discount	30%

CHICAGO

List price	$4.50 to $6.00
Discount	25% to 30%

WIRE, ANNUNCIATOR

NET PRICE—NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.44¼
No. 18, full spools	0.43¼

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.57 to $0.65
No. 18, full spools	0.47 to 0.55

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net—		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
11	$15.00-$18.00	$13.00	$10.25-$11.50
12	23.25- 25.41	21.30- 21.78	15.97- 19.35
10	32.40- 35.21	29.70- 30.18	22.13- 27.00
8	45.70- 49.12	41.90- 42.12	30.88- 38.00
6	72.40- 77.84	66.35- 66.72	48.93- 60.30

CHICAGO

	Price per 1000 Ft. Net—		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00	$13.00	$11.50
12	25.33-$26.28	22.02-$25.33	18.35- 20.93
10	36.48- 36.54	27.94- 31.26	22.86- 29.23
8	42.54- 51.57	38.99- 44.13	31.90- 41.36
6	67.38- 88.38	56.15- 75.61	50.53- 70.70

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 8 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$33.25 to $35.25
25 to 50 lb	31.25
50 to 100 lb	28.25 to 34.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$35.42 to $40.35
25 to 50 lb	34.42 to 39.35
50 to 100 lb	33.42 to 38.35

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Shade Holders

Harvey Hubbell, Inc., of Bridgeport, Conn., has placed on the market a line of brass shade holders of the three-screw type for use with medium and mogul base weatherproof and porcelain

FOR USE WITH MEDIUM AND MOGUL BASE SOCKETS

sockets. The attachment to the socket is accomplished by means of a clamp and screw arrangement which guarantees a firm grip. The holders are given a bright dip and lacquered finish, making an attractive as well as useful device.

Floodlighting Projector

A floodlighting projector designed for use of 300-watt to 1000-watt standard Mazda "C" lamps has been placed on the market by the George Cutter Company, South Bend, Ind. It is called the "Standard" floodlighting projector.

The new unit has the same general construction features as the Cutter "Universal" projector for floodlighting lamps, features which have made the latter unit popular because of its adaptability for the many purposes for which floodlighting projectors can be used. They include weather-proof and fume-proof body or housing cast of aluminum or gray iron and forming absolute protection for the lamp and reflector, a method of mounting that permits of the projection of light in

FOR STANDARD MAZDA "C" LAMPS

any direction in any plane, construction of the housing that permits of the interchange of narrow or wide angle-beam reflectors, and sectional wireglass doors to minimize breakage.

In this projector the socket is adjustable both horizontally and vertically for focusing the lamp or changing the width of the beam. When adjustment is made the socket is locked in position. Reflectors are made of copper, heavily silver-plated and finished with a coat of water and fume-proof lacquer. The narrow-beam reflector has a divergence of 10 deg. and the wide-angle-beam reflector a divergence of 30 deg. They are designed to redirect the maximum amount of light from the lamp.

Disk Fans

The Bicalky Fan Company of Buffalo, N. Y., has developed a disk fan that is constructed entirely of steel. The hub is conical in shape, thereby offering the least resistance to the air, it is pointed out. This fan is equipped

CONSTRUCTED ENTIRELY OF STEEL

with ball bearings running in oil. The center shaft is stationary and the steel hub revolves in the shaft. The wheel shaft is hollow, thus providing a large oil chamber, so that the fan requires oiling only occasionally. The fan is equipped with self-oiling babbitt bearings.

Electric Heating Pad

The Wirt Company of Philadelphia has developed an electric heating pad in which the heat-producing element is inclosed between two sheets of rubberized fabric, permanently vulcanized together. The wire is laid in parallel strands 1/16 in. (0.16 cm.) apart.

The manufacturers point out that many pads are equipped with a thermostat. A thermostat in this pad is unnecessary. The wire that is used is such that as the heat increases the resistance increases, automatically reducing the watts consumed. Hence, it is pointed out, the wire in the pad is itself a thermostat, which will always work, providing absolute protection against excessive heat. The pad itself may be washed or scrubbed with soap and water as often as necessary or may be sterilized by dipping in boiling water for a minute or two. The rubberized fabric will not permit the water to come in contact with the resistance wires. The slip-on cover furnished with the pads is easily removed. It is furnished with 8 ft. (2.4 m.) of cord and attachment plug. Close to the pad is a slip connector, which enables the user to shut off the heat.

Plastic Refractory for Baffles

Jointless and gas-tight baffles can be made by the use of a refractory known under the trade name of plastic firebrick and manufactured by the Betson Plastic Fire Brick Company of Rome, N. Y. This material was originally introduced for lining boiler furnaces and is compounded of refractory materials so prepared as practically to eliminate expansion and contraction with changes in temperature.

Where this material is used there is no restriction upon the shape or size of the baffle, and the latter can therefore be arranged in any form desired. In cross-baffled boilers, for example, it is becoming the practice to slope or incline the baffles, so that the gas passage will contract progressively from the point where the gases enter the tube to the point where they leave, in order to maintain a uniform gas velocity, in spite of the shrinkage of gas volume with cooling. This is easily accomplished with the plastic material, whereas with the solid bricks or blocks a special block is required which can be inserted and maintained in place only with difficulty, if at all.

This material also finds use as a substitute for special forms of bricks or blocks, as, for example, where the front headers of horizontal water-tube boilers rest upon the front arch. Its use for lining furnace and combustion chambers, including front arch, side walls, bridge wall, rear arch, etc., has been described previously. The exacting tests to which it has been put in direct contact with the fuel bed and with the gases of combustion before they have been cooled by the boiler surfaces proves its ability to withstand high temperature gases and stresses such as are encountered in furnace construction for long periods without crumbling or otherwise deteriorating.

Disk Stoves

A four-heat disk stove is being manufactured by Landers, Frary & Clark of New Britain, Conn. A disk 3 in. (7.6 cm.) in diameter is surrounded by a ring 6 in. (15.2 cm.) in diameter. Each has a heating unit which can be

FOUR-HEAT STOVE

operated independently or in conjunction with the other. Two single stoves are thus combined in one and at a cost less than that of the regular two-heat 6-in. disk stove, it is said.

The nichrome wire heating unit is incased in a polished and blued cast-iron top. The stand is nickel-plated. The wattage of each unit is 300 and the total wattage 600. A neat convenient handle is provided. This device has a wide field in homes, laboratories, schools, shops, drug stores, prescription counters and hospitals.

Automatic Starting Switch for Squirrel-Cage Motors

The control from a remote point of the starting and stopping of single-phase and standard polyphase motors, as well as high-torque polyphase motors, is often desirable, if not essential. Such installations in connection with pumps for railroad water tanks and various other pump and compressor applications, coal and ash conveyor installations, etc., are at once called to mind. The control may be a float switch closing and opening the control circuit with changes in the water lever of a tank, or a pressure regulator performing similar service in a closed system, or control may be had by push-button stations, one button being normally open and one normally closed. In any case some form of automatic device must be used, unless the motor is very small, to handle the motor current. An automatic starting switch which is of the double-pole clapper type is made for single-phase and standard polyphase motors up to 15 hp. and for high-torque polyphase motors up to 50 hp. Besides the double-pole switch, two inverse-time-element overload relays are mounted on the same slate panel, which is supported on a pressed-steel frame.

When used with a float switch, pressure regulators or a snap switch, the overload relays are arranged for manual reset; hence when an overload occurs the operator is required to go to the starting panel before the motor can again be started, a feature which results in more careful attention to operating conditions and less motor abuse.

When used with three-wire controlling apparatus, such as two push-buttons, one normally open and one normally closed, the overload relays can operate with a self-resetting feature.

The wiring diagram below shows the advantages of this feature and why depressing the start button will immediately restart the motor after a shutdown from overload trip, voltage failure or intentional stopping with stop button.

Except on some of the smaller sizes, both poles of the main contactor are equipped with powerful magnetic blowouts. The clapper switch fingers are standard C-H butt contact construction with hard-drawn copper tips. By the use of shading coils these contactors gain great holding power and there is a total absence of magnetic hum.

The relays used on these panels are of that type in which the length of time between the instant the overloading condition arises and the instant of opening the control circuit is inversely proportional to the amount of the overload. They give adequate protection to polyphase induction motors against excessive continued overloads and yet permit a large inrush of starting current.

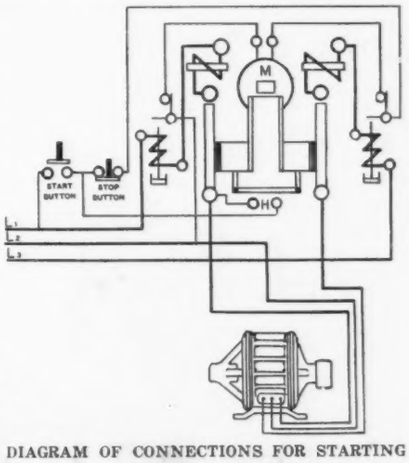


DIAGRAM OF CONNECTIONS FOR STARTING SWITCH WITH OVERLOAD RELAYS HAVING SELF-RESETTING FEATURE

The complete panel is known as an "across-the-line type self-starter" and is manufactured by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

Safety Switch

The Metropolitan Electric Manufacturing Company, Boulevard and Fourteenth Street, Long Island City, New York, is manufacturing a safety switch for the W. A. McCombs Company of Pittsburgh, Pa. This is a quick-break switch mounted in a box said to be unusually strong. The cover is in three pieces. The upper and lower doors each move on separate hinges and the middle section is attached to the box by two screws. The top door over the switch compartment may be opened by means of a lock which permits ready inspection. The lower door over the fuse compartment is held by a snap catch. No live parts are exposed. The safety switch rated at 30 amp. is a 60-amp. switch with 30-amp. fuse spacings to give mechanical strength.

Combination Air Compressor and Grinder Outfit

The United States Air Compressor Company, Cleveland, Ohio, has recently announced a combination air compressor and grinder outfit which is especially suitable for service in garages and similar places where compressed air is required.

The outfit consists of a self-oiling air compressor with filtering trap, check valve and safety valve, buffing head, 30-gal. (113.6-l.) tank, air-pressure gage, needle-point valve, pipe and fittings, armored hose, automatic air chuck, 6 ft. (1.8 m.) of armored cable with plug, all mounted on a metal base to form a compact unit which requires but little floor space.

The outfit is equipped with an extra tank, the function of which is to permit the motor to start against no pressure and attain full momentum before assuming its full load, thereby eliminating the cause of burned-out motors and other motor trouble.

The outfit is equipped with a 1-hp. Robbins & Myers motor which permits the compressor and buffing head to operate at the same time. Outfits without this buffing head are equipped with a 0.5-hp. Robbins & Myers motor.

Waffle Iron

Waffle irons for lamp sockets are now being manufactured by Landers, Frary & Clark of New Britain, Conn. Highly polished nickel finish gives them a pleasing appearance. This, combined with aluminum grids which require no grease and are smokeless, makes the iron desirable for dining-table use.

The waffles are 3½ in. by 3½ in. (8.9 cm. by 8.9 cm.), and two are prepared simultaneously. Only a minute and a

CAN BE USED ON THE DINING TABLE

half is required for cooking. These irons are available in standard voltage ranges, wattage 600. Gift shops, tea rooms, confectionery shops and soda counters will find ready sale for waffles prepared in this way.

Trade Notes

P. B. ZIMMERMAN has been appointed publicity manager of the National Lamp Works, succeeding N. H. Boynton. Mr. Zimmerman was editor of the *Mazda Stimulator*.

THE GENERAL STORAGE BATTERY & REPAIR COMPANY, Jersey City, N. J., is planning to increase its present capacity and is making improvements and additions to its plant.

THE NATIONAL LAMP WORKS OF THE GENERAL ELECTRIC COMPANY have opened at Detroit, Mich., a new, completely equipped factory for the production of National Mazda miniature lamps.

THE WEEHAWKEN TUNGSTEN LAMP COMPANY of Weehawken, N. J., has plans under consideration for the reconstruction of its tungsten-lamp plant, recently destroyed by fire with a loss of $25,000.

THE PERMUTIT COMPANY of New York City, manufacturer of water-softening and rectification apparatus, has removed from 30 East Forty-second Street to 440 Fourth Avenue, where the entire top floor will be occupied by its offices.

THE WESTINGHOUSE ENGINEERING & MANUFACTURING COMPANY, East Pittsburgh, Pa., has leased for a period of years the Baxter Stove Company at Mansfield, Ohio, with the intention of consolidating at this point the manufacturing of heating appliances now being carried on at some of the other Westinghouse plants.

THE NATIONAL CONDUIT & CABLE COMPANY of New York City at a meeting of the directors last week elected George J. Jackson president, to succeed Edward S. Perot, and Norton A. Howard, formerly secretary, was chosen vice-president, to take the place of Edward S. Perot, Jr. H. J. Pritchard, formerly treasurer, was elected secretary and treasurer to succeed Mr. Howard.

THE BUCKEYE DIVISION OF THE NATIONAL LAMP WORKS OF THE GENERAL ELECTRIC COMPANY has moved its Chicago offices from 54 West Lake Street to larger quarters in the Lemoyne Building, at Wabash and Lake Streets. N. H. Boynton has been appointed general manager of the company, succeeding Leroy P. Sawyer, who goes to Cleveland to take up executive work with the National Lamp Works.

THE UNO-LITE COMPANY OF AMERICA, which was originally organized as a partnership to sell reading lamps, has been incorporated under the laws of the State of Indiana. The capitalization consists of 300 shares of common stock at $50 par value and 400 shares of preferred stock at $50 par value, making a total capitalization of $35,000. The preferred stock is cumulative 7 per cent and shares in addition proportionately with common stock in all profits of the company after 20 per cent has been paid on the latter. The officers of the Uno-Lite Company include H. H. Harrison and R. A. MacGregor of the Merchants' Heat & Light Company, Indianapolis, Ind.

BENJAMIN F. CHASE, United States Consul at Santa Rosa, Costa Rica, informs the State Department that in the fire which on Dec. 28 last destroyed the American consulate with many other buildings all catalogs, directories and year books of chambers of commerce, and trade journals were lost. A permanent new office has now been secured and occupied, where such publications can be properly displayed. It is requested that firms seeking sales in that market send copies of their latest catalogs and that chambers of commerce send their year books and directories for the files of the consulate. It is well to note that the cost of receiving parcel-post packages is 75 centavos (about 16 cents at present rate) per package and that only the small catalogs need be sent.

THE AMERICAN GEAR MANUFACTURERS' ASSOCIATION will hold its second annual convention at Green Brier Hotel, White Sulphur Springs, W. Va., on April 18, 19 and 20. An address by a representative of the United States Chamber of Commerce, of which the association has just become a member, will bring matters of timely interest before the association. The convention will begin with meetings of committees on the morning of April 18. At 1.30 p. m. the first session will open with an address by President F. W. Sinram on "The A. G. M. A. Past, Present and Future." Following the address by the Chamber of Commerce representative, C. R. Poole will talk on the "Hardening and Heat Treating of Gears" and B. F. Waterman will present the report of the standardization committee. The following morning's session will include reports of officers and committees. An informal banquet will be held in the evening. The next morning a paper on "Uniform Cost Accounting" will be presented by J. H. Dunn, and one on "Hobs and Hobbing Machines" by a representative of the Barber-Coleman company. A program of sports and amusements has also been arranged.

Trade Publications

FANS AND BLOWERS.—The Bicalky Fan Company of Buffalo, N. Y., has prepared a circular descriptive of its fans and blowers.

LIGHTING UNIT.—The Reflectolyte Company, 914 Pine Street, St. Louis, Mo., has prepared a folder descriptive of its "Reflectolyte."

SOCKETS AND RECEPTACLES.—Pass & Seymour of Solvay, N. Y., are distributing leaflet 42-A, descriptive of their key and keyless sockets and receptacles.

CENTRIFUGAL PUMPS.—The Manistee Iron Works Company of Manistee, Mich., has prepared its bulletin No. 54, descriptive of its multi-stage centrifugal pumps.

AUTOMATIC STARTERS.—The General Electric Company of Schenectady, N. Y., has prepared a circular descriptive of its automatic starters for direct-current motors.

FLOODLIGHTING PROJECTORS.—Bulletin 3338, descriptive of Cutter "Universal" and "Standard" floodlighting projectors, is being distributed by the George Cutter Company of South Bend, Ind.

REDUCTION GEARS.—Marine application of reduction gears of floating-frame type is the subject of reprint No. 62, now being distributed by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa.

SMALL-GEARED TURBINE-GENERATOR UNIT.—The Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has prepared a leaflet descriptive of its geared turbine-generator units in sizes from 15 kw. to 50 kw.

HEATING PAD.—The Wirt Company of Philadelphia has prepared a folder descriptive of its electric heating pad. The heat-producing element of this pad is inclosed between two sheets of rubberized fabric permanently vulcanized together.

ELECTRIC HEATING DEVICES.—The Simplex Electric Heating Company, 85 Sidney Street, Cambridge, Mass., is distributing a folder containing bulletins descriptive of its electric heating devices. A revised list and index, dated Feb. 1, 1918, is included.

JOBBERS' CATALOG.—The Monarch Electric & Wire Company, Adams and Desplaines Streets, Chicago, has ready for distribution its catalog No. 20, which contains over 1100 pages. This catalog has a wire list which is said to be the most complete published up to the present time. The book contains over 100 pages of information such as the Fire Underwriters' rules, illuminating data, industrial motor application and useful data covering storage batteries. It also catalogs a complete line of electrical supplies and construction material, well illustrated.

FLATIRONS.—Landers, Frary & Clark of New Britain, Conn., have prepared a handsome life-sized window-display cut-out in nine colors, showing an attractive girl using a real Universal iron. It measures about 34 in. high by 24 in. wide. This will be ready for distribution about April 30. Dealers may arrange with their jobbing houses for these displays. The spring national advertising of Universal electric home needs will feature this cut-out, and this affords the dealer an excellent opportunity to identify his store with the Universal trade name and national advertising.

ELECTRICAL EQUIPMENT FOR BREWERIES.—The Cutler-Hammer Manufacturing Company of Milwaukee, Wis., has just issued publication No. 220, a four-page pamphlet illustrating and describing C-H electric beer-vat dryers and stating some advantages of drying beer vats by electricity. The C-H beer-vat dryers are made with two and three heats and in three sizes, ranging from 750 watts to 1250 watts on low heats and from 3000 watts to 5000 watts on high heats. The pamphlet also illustrates a direct-current motor starter, a porcelain push socket and a porcelain push switch especially adapted for use in breweries and other damp places.

ELECTRICAL HEATING.—Of interest to everybody connected with the heating of baking, drying and japanning ovens is reprint No. 66, just issued by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. This includes an article on "Electrically Heated Japanning Ovens" by C. F. Hirshfield, reprinted from the *N. E. L. A. Bulletin*, and "Heat Calculation for Baking and Drying Ovens," by W. S. Scott, reprinted from the *Electric Journal*. Thus there are grouped under a single cover an article giving general considerations in favor of electrical heating for this purpose and an article giving the detailed method of calculation for the amount of heat required to raise the temperature of the work, of the supporting and carrying parts, such as trucks, and of the ventilating air. How to compute the losses from the external surface of the oven and the heat required to raise the temperature of the oven walls, etc., are also told. This publication should be of much value to central-station solicitors who are endeavoring to interest their customers in the electrical heating of ovens, as well as to present and prospective users of such equipment.

New Incorporations

THE UNITED STATES TURBINE MANUFACTURING COMPANY of Quincy, Mass., has been incorporated with a capital stock of $50,000. George A. Weaver is president.

THE ELK PARK (N. C.) ELECTRIC LIGHT & POWER COMPANY has been incorporated with a capital stock of $25,000 by A. P. Brinkley, A. P. Brinkley, Jr., and Hall H. Brinkley.

THE WOODWARD-WIGGINS ELECTRIC COMPANY of Orangeburg, S. C., has been incorporated with a capital stock of $9,000 by J. L. Woodward and J. C. Wiggins, both of Orangeburg.

THE ROCK CITY ELECTRIC COMPANY of Nashville, Tenn., has been incorporated by J. C. Campbell, W. C. Campbell, H. S. Sumner and others. The company is capitalized at $50,000.

THE D. & F. ELECTRICAL ENGINEERING COMPANY of Ogdensburg, N. Y., has been incorporated by S. J. Delaney, F. J. Francis and A. T. Whalen of Ogdensburg, N. Y. The company is capitalized at $10,000.

THE AMERICAN AUTOMATIC SIGNAL COMPANY of New York, N. Y., has been incorporated with a capital stock of $350,000 by S. B. Howard, G. V. Reilly and A. W. Britton, 28 Nassau Street, New York City.

THE NATIONAL GAS & POWER COMPANY of Indianapolis, Ind., has been incorporated by E. C. Lewis, W. W. Wiswell and J. B. Detwiler. The company is capitalized at $100,000 and proposes to generate and distribute electricity.

THE GRAFTON (ILL.) ELECTRIC LIGHT & POWER COMPANY has been chartered with a capital stock of $10,000 by William J. Brower, Robert L. Mayensburg, August Miller, D. C. Slaten, John N. Eastman, E. P. Edsall and H. A. Patton.

THE SANTO DOMINGO ELECTRIC LIGHT & POWER CORPORATION of New York, N. Y., has been incorporated with a capital stock of $300,000 to generate and distribute electricity. The incorporators are: Alex. A. Oldrini, Jose A. Losada and Zachary M. Delman.

THE UNITED STATES ELECTRICAL SUPPLY COMPANY of Peoria, Ill., has been organized with a capital stock of $100,000 to do a general electrical contracting business. Walter O. Ireland is to be president of the new company and B. P. Crawley vice-president.

THE OHIO TUEC VACUUM CLEANER COMPANY of Toronto, Ont., Can., has been chartered with a capital stock of $50,000 to manufacture vacuum cleaners, machinery, etc. The incorporators are: Joseph M. Bullen, 44 King Street West; Harold L. Steele, Wendell Osborne and others.

THE ACME ENGINEERING COMPANY of Toronto, Ont., has been incorporated by Ewart Lynch, Traders' Bank Building; D. B. Coleman, F. A. D. Campbell and others. The company is capitalized at $125,000 and proposes to manufacture machinery, tools, electrical equipment, etc.

THE CHICKASAW (ALA.) UTILITIES COMPANY has been incorporated with a capital stock of $50,000 as a subsidiary of the Tennessee Coal, Iron & Railroad Company. The officers are: George G. Crawford, president; H. C. Ryding, vice-president; L. T. Beecher, secretary and treasurer, all of Birmingham.

New England States

DENMARK, ME.—A joint petition has been made to the Public Utilities Commission by the Denmark (Me.) Light & Power Company and the Western Maine Power Company of Limerick, asking authority for the latter to purchase the property and holdings of the former.

PORTSMOUTH, N. H.—Bids will be received at the Bureau of Yards and Dock, Navy Department, Washington, D. C., until March 25 for furnishing and supervising the installation of two 700-gal. per minute electrically driven centrifugal booster pumps and equipment at the navy yard, Portsmouth. Drawings and specifications No. 2846 may be obtained on application to the above bureau or to the commandant of the navy yard named.

BOSTON, MASS. — The Tileston & Hollingsworth Company, paper manufacturers, 49 Federal Street, is changing the motive power of its plant at 892 River Street, Hyde Park, from steam to electricity. The work consists of a new transformer house, new reinforced concrete motor and other machinery foundations. The Aberthaw Construction Company, 27 School Street, Boston, has the contract.

IPSWICH, MASS.—At the annual town meeting held recently the Water and Light Commissioners were authorized to extend both the water and electric systems.

NEW BEDFORD, MASS.—The Union Street Railway Company has awarded contract to the J. W. Bishop Company of Worcester for the construction of the superstructure of a building to be used as a boiler house and turbine room. The building will be 98 ft. by 126 ft., and will cost about $135,000.

NEWBURYPORT, MASS. — Application has been made by the New England Telephone & Telegraph Company to the Council for permission to construct an underground conduit and erect pole lines for distributing purposes on State Street from High Street to the Newbury line and on intersecting streets.

PAWTUCKET, R. I. — Preparations are being made for the construction of a new power plant in the rear of Park Place to furnish light and heat for the large business blocks of the Taylor Estate in Main and Broad Streets. The new power plant is made a necessity owing to the decision of the Blackstone Valley Gas & Electric Company to abandon its heating plant next fall.

GROTON, CONN.—The Public Utilities Commission has granted the petition of the Shore Line Electric Railway Company to supply electricity to the Croton Iron Works for its shipbuilding plant. The borough municipal plant is not able to furnish an adequate supply.

Middle Atlantic States

BINGHAMTON, N. Y.—The Public Service Commission has granted the Binghamton Light, Heat & Power Company permission to sell $100,000 refunding and improvement bonds.

BUFFALO, N. Y.—Plans are being prepared by the Lackawanna Steel Company for the construction of a central turbo-generator power plant, 100 ft. by 190 ft., one story high, to cost about $200,000.

BUFFALO, N. Y.—Contracts have been awarded by the Transmission Ball Bearing Company, 1050 Military Road, Buffalo, for a one and two-story addition, 175 ft. by 350 ft., to its plant at Military Road and the Central Railroad, to cost about $150,000.

BUFFALO, N. Y.—Plans are under consideration by the City Council for equipping the Buffalo Belt Line for electrical operation in order to increase the efficiency of the system for the transportation of workers to the various plants engaged upon war contracts.

BUFFALO, N. Y.—Plans have been completed by the New York Telephone Company for the acquirement and operation of the systems of the Federal Telephone & Telegraph Company, the Niagara County Home Telephone Company and the Chautauqua County Telephone Company of Buffalo.

NEW YORK, N. Y.—Permit has been taken out by the New York Edison Company for the erection of a repair shop, 50 ft. by 70 ft., at 720 First Avenue.

NEW YORK, N. Y. — The Long Island Lighting Company has petitioned the Public Service Commission for permission to purchase the properties of the Sag Harbor (N. Y.) Light & Power Company and the Riverhead (N. Y.) Electric Light Company.

NEW YORK, N. Y.—The Emergency Fleet Corporation has awarded the Lord Construction Company, 105 West Fortieth Street, New York, N. Y., a contract for fitting out twenty wooden hulls being built at various shipyards. The work will include the installation of engines, boilers and all similar equipment and supplies.

NORWICH, N. Y.—The Public Service Commission has granted the Norwich Gas & Electric Company permission to issue $80,000 in bonds and $38,500 in capital stock.

UTICA, N. Y.—A committee has been appointed by Mayor Smith to investigate the proposal that the city of Utica develop the water powers in nearby streams and erect an electric transmission line to the city. The plan contemplates using the power developed to operate war industries here.

AMPERE, N. J. — A permit has been taken out by the Crocker-Wheeler company for the construction of an extension to its power house.

CAMDEN, N. J.—A permit has recently been taken out by the New York Shipbuilding Company for the erection of an addition, 110 ft. by 115 ft., to the power house at its plant.

HACKENSACK, N. J.—The Gas & Electric Company of Bergen County has petitioned the Board of Public Utility Commissioners for permission to issue $700,000 in bonds, the proceeds to be used for extensions, improvements, etc., in its plant and system.

HOBOKEN, N. J.—Plans are being prepared for the erection of a building near Fourteenth Street, Hoboken, for the United States government, to cost about $1,000,000. It will be used for the manufacture of army equipment, as well as for storing, handling and shipping of materials, and will be known as the Expeditionary Depot.

NEWARK, N. J.—Plans are under consideration by the City Commission for the installation of a new heating plant in the City Hall at once. The proposed plant will furnish heat for the police headquarters soon to be formally opened.

PERTH AMBOY, N. J.—Plans have been filed by the American Smelting & Refining Company for the construction of an addition, about 60 ft. by 70 ft., to the power house at its plant at Maurer. Contract for construction of building has been awarded to Ira Crouse, 495 State Street, Perth Amboy.

PITMAN, N. J.—The Board of Public Utility Commissioners has given its approval to the application of the Electric Company of New Jersey for a bond issue of $197,000, the proceeds to be used for extensions, improvements, etc.

TRENTON, N. J.—The City Commissioners are considering plans for operating under municipal ownership the system of the Trenton & Mercer County Traction Corporation.

BRADFORD, PA.—A portion of the power plant of the Boviard & Seyfang Manufacturing Company was recently destroyed by fire, causing a loss of about $10,000.

COALDALE, PA.—Plans are being prepared by Louis Stockton, architect, 35 West Thirty-ninth Street, New York City, for an addition, 40 ft. by 60 ft., to the power house of the Panther Creek Valley Hospital.

COLLEGEVILLE, PA.—The entire electrical equipment of the power house of the Reading Transit & Light Company at Collegeville has been purchased by Henry Potts & Company, 650 Real Estate Trust Building, Philadelphia, Pa.

EASTON, PA.—The Pennsylvania Utilities Company has completed the erection of a new tie line between its system and that of the Lehigh Valley Transit Company at Allentown. A section of the new line, which will provide for an interchange of about 1200 kw., facilitating operation in event of a breakdown in either system, has been equipped for 13,200 volts, and the remainder for 33,000 volts.

HARRISBURG, PA.—The Harrisburg Railways Company in connection with other improvements to its plant will begin work on the installation of automatic stokers in its main power plant and substation at Reily and Marion Streets.

HARRISBURG, PA.—Application has been filed with the Public Service Commission by the Penn Mills Light, Heat & Power Company, the Bernville Light, Heat & Power Company and the Jefferson Light, Heat & Power Company, all of Berks County, to consolidate.

HARRISBURG, PA.—Application has been filed with the Public Service Commission for permission to consolidate the following companies: The Port Allegheny Power Company, the Liberty Township Power Company, the Smithport Power Company, the Lafayette Township Power Company, the Bradford Township Power Company and the Keating Power Company, all of McKean County.

PHILADELPHIA, PA. — Contract has been awarded by the Philadelphia & Reading Railway Company for the construction of a power house, one and two story, at Tulip and Somerset Streets, to the F. W. Mark Construction Company.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Railway Company has taken out a permit for the construction of a new substation, 40 ft. by 50 ft., two stories high. The cost is estimated at about $10,000.

WILMINGTON, DEL.—Notice has been filed with the People's Heat, Light & Power Company of a change in name to the Seaboard Electric Company.

WILMINGTON, DEL.—Preparations are being made by the Sugar Refining Company for the erection of a large power house in connection with its proposed new sugar refinery on the Delaware River, for which preliminary plans are being prepared. The cost of the entire project is estimated at about $10,000,000.

PRINCETON, W. VA.—The City Council is considering replacing the arc lamps now in use with incandescent electric (three-lamp clusters) lamps.

HAMPTON ROADS, VA. — Plans are being prepared by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the installation of a new fire alarm system at the local yards.

NORFOLK, VA.—Plans have been prepared for additions to the Norfolk Navy Yard, consisting of a new pattern shop, to cost about $600,000, and a power plant, to cost $575,000, and auxiliary structures.

PETERSBURG, VA.—The Virginia Railway & Power Company is planning to erect an electric transmission line from Petersburg to Norfolk to supply electricity in Petersburg and Norfolk and to the towns between the two cities. The cost of the work is estimated at about $750,000. Contracts, it is understood, will soon be awarded for the proposed work. The proposed line will provide connections with the three power plants in the cities of Richmond, Norfolk and Petersburg. In case of accidents to any of the plants service can be supplied by the two other stations.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 1724—50,700 ft. lead-covered wire, 400,000 ft. twisted lamp cord, 37,000 lb. weatherproof wire, and 202,500 ft. rubber-covered wire; Schedule 1725—140,000 ft. double, duplex armored wire, 800,000 ft. double duplex leaded wire, 70,000 ft. double duplex plain wire, 158,000 ft. leaded and armored single conductor wire, 262,000 ft. single conductor wire, 21,000 ft. interior communication wire, and 113,000 ft. interior communication leaded and armored cable. Philadelphia, Pa., Schedule 1725—a quantity of magnet wire. Application for proposal blanks should designate the schedule desired by number.

North Central States

ASHTABULA, OHIO.—The residents on Bancroft Street have petitioned the City Council for sidewalks, grading and electric lamps for that thoroughfare.

BUCYRUS, OHIO.—Preparations are being made by the Bucyrus Light & Power Company to increase the ouput of its plant. Work will begin at once on the installation of machinery capable of developing 2500 kw., which will increase the capacity of the plant by 150 per cent. The present output of the plant is 1750 kw.

CANTON, OHIO.—A tentative site, it is announced, has been selected for the new roundhouse and power plant to be erected in connection with the freight yards under construction by the Wheeling & Lake Erie Railway Company, to cost about $500,000. The cost of the power plant and roundhouse is estimated at about $250,000.

CINCINNATI, OHIO.—Plans are being prepared by the United States Electrical Tool Company for an addition to its factory, 60 ft. by 100 ft.

CINCINNATI, OHIO.—Two 30,000-kva. units of the new 125,000-kva. generating

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

plant of the Union Gas & Electric Company, now under construction, will be placed in operation this summer. Work on the new 13,200-volt transmission system is nearly completed. C. W. De Forest is manager of the electrical department.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, Ohio, until March 22, for electric meters. Specifications may be obtained at the office of the division of light and heat.

COLUMBIA, OHIO.—The Columbia Gas & Electric Company has been awarded the contract to furnish electricity to operate the motor-driven pumps to be installed at the auxiliary water-works pumping station.

FREMONT, OHIO.—The Ohio State Power Company is building a large addition to its Ballville plant, which when completed will increase the output to 24,000 hp.

GERMANTOWN, OHIO. — The Town Council, it is reported, has asked the Dayton Power & Light Company to prepare plans showing how the company would light the town, and to submit a schedule of prices for both municipal and private lighting service. Thomas F. Keely is representative of the company.

SANDUSKY, OHIO.—The Sandusky Gas & Electric Company has secured a contract from the Brightman Nut & Manufacturing Company to supply electricity (125 hp.) to operate the plant of the latter.

WATERVILLE, OHIO. — The Defiance (Ohio) Gas & Electric Company is contemplating extending its service to the village of Waterville. Application has been made by the company to the Commissioners of Lucas and Wood Counties for permission to place lamps on the Waterville bridge.

YOUNGSTOWN, OHIO.—The Mahoning & Shenango Railway & Light Company is considering plans for the reconstruction of its line between Sharon and the Wheatland Borough limits, to cost about $150,000.

MAYFIELD, KY.—The city of Mayfield has taken over the water and light plants of the Mayfield Water & Light Company to be owned and operated by the municipality.

ANDERSON, IND.—Improvements to be completed by the Union Traction Company of Indiana during 1918 include the erection of a transmission line and other apparatus for operating the Muncie-Portland line with energy from the central power plant at North Anderson.

COLUMBUS, IND.—Work is now under way for replacing the street arc lamps now in use with electric incandescent street lamps.

ELKHART, IND.—The St. Joseph Valley Railway Company, it is reported, is contemplating the construction of an extension of its line from Elkhart to Toledo.

INDIANAPOLIS, IND.—The contract for furnishing and erecting eight bronze standards of special design for the Depew Memorial Fountain has been awarded to the Hatfield Electric Company of Indianapolis, at $4,476.

CHICAGO, ILL.—The Public Utilities Commission has authorized the Public Service Company of Northern Illinois to issue $1,334,000 refunding mortgage bonds.

CHICAGO, ILL.—The Ilg Electric Ventilating Company has purchased a site at Elston Avenue and Snow Street, Chicago, on which it will erect a group of manufacturing buildings, to cost about $750,000. Plans are being prepared by Lebenbaum, Marx & Vigeant, architects, 175 West Jackson Boulevard, for the proposed buildings, which will be built in units 60 ft. by 300 ft., connected by passageways.

HARRISBURG, ILL.—The Public Utilities Commission has granted the Southern Illinois Light & Power Company permission to issue $279,000 in bonds and $402,100 in capital stock. The company was also given a certificate of convenience and necessity to operate a plant.

BUTTERNUT, WIS.—The Butternut Electric Light & Power Company is planning to install an additional 3-wire generator of about 15 kw. capacity and a kerosene oil engine with a rating of from 20 to 25 hp. this year. W. J. Schulz is manager.

MILWAUKEE, WIS.—Plans are being prepared by the A. C. Electric & Novelty Company, 224 Fourth Street, Milwaukee, for rebuilding its plant and warehouse, which was recently damaged by fire, causing a loss of about $25,000. Much of the equipment was badly injured and will have to be replaced.

NEENAH, WIS. — The City Council is considering the purchase of electrical equipment for the city stone quarry.

PINE CITY, MINN.—Improvements are contemplated by the Eastern Minnesota Power Company, consisting of the installation of a 500-kw. steam turbine, also developing a water power and the erection of a 10-mile electric transmission line to connect with its present plant.

ST. PAUL, MINN.—Contracts have been closed by the Northern States Power Company for furnishing electricity (22,000 hp.) for industrial motors. With the exception of two munition plants, it is stated that the new business is of a permanent character.

TROMMALD, MINN.—The installation of an electric-lighting system in the new town of Trommald is reported to be under consideration.

VIRGINIA, MINN.—Plans are being considered by the Virginia Board of Education for the installation of an electric light and power plant in connection with the new school building.

DUBUQUE, IOWA.—The power plant of the Farley & Loetscher Company was recently damaged by fire, causing a loss of about $20,000.

DUNLAP, IOWA.—Bids will be received by the Board of Education of Dunlap until April 10 for the construction of a high school building, including electric wiring, vapor steam heating, plumbing, etc. The cost of the building is estimated at about $75,000. J. H. Craddock & Company, 504 Farnum Building, Omaha, Neb., are architects.

SCOTLAND, S. D.—At an election held recently the proposal to issue $35,000 in bonds for the installation of a municipal electric light plant was defeated. Electrical service is now furnished by the South Dakota Light & Power Company of Armour. Improvements, it is understood, will now be made to the local system.

KANSAS CITY, MO.—The Interurban Central Station Company has filed a bond of $50,000, thus assuring the erection of the new interurban union station at Tenth and McGee Streets.

KANSAS CITY, MO.—A permit has been taken out by the Kansas City Light & Power Company for the construction of its proposed new plant at Front Street and Park Avenue. The new building will be 244 ft. by 185 ft., four stories high. The cost of the first unit is estimated at $1,700,000.

ST. JOSEPH, MO.—The Lawhon, Stamey Construction Company, 905 Edmond Street, St. Joseph, has been awarded the general contract for construction of a department store, to be erected at the corner of Sixth and Francis Streets, to cost about $200,000. Contract for electric wiring and elevators has not yet been awarded.

BUNKER HILL, KAN. — The installation of a municipal electric-light plant in Bunker Hill is under consideration.

YATES CENTER, KAN.—The City Council has adopted ordinances providing for submitting the question of municipal ownership of the water works, electric-light plant and ice plant to the voters at the coming election.

Southern States

BADEN, N. C. — The Tallassee Power Company, it is reported, will erect 300 additional buildings at its plant this spring.

BLADENBORO, N. C.—The Town Commissioners have made arrangements with the Bladenboro Cotton Mills for furnishing electricity for lighting the streets of the town. Electric wires have been erected, and it is understood that contract has been placed for lamps.

PINE LEVEL, N. C.—The Citizens' Power & Light Company will erect 13 miles of electric transmission line, connecting up two towns, one having a population of 2500 and the other 5000. A substation will be erected in each town. C. I. Goodwin is owner.

SUMTER, S. C.—The City Council has authorized Mayor Jennings to engage an engineer to make investigations and estimates of the cost of establishing a municipal electric-light plant with a view of calling an election to submit the proposal to establish a municipal electric plant to the voters.

JACKSONVILLE, FLA.—The City Commission has adopted the resolution providing for the extension of the electric transmission lines of the municipal electric-light plant to the shops of the Seaboard Airline Railroad Company to furnish electricity. The railroad agrees to pay the cost of erecting the transmission line, which is estimated at about $15,000.

COLUMBIA, TENN.—Options on sites and land on Duck River have been obtained by M. R. Stern, engineer of Nashville, representing capitalists who have developed water power in a number of towns in middle and east Tennessee. The proposed plant will be located on the site now known as the Ashton Mills, on the north edge of Columbia. The dam, which is 6 ft. high, will be raised 6 ft.

HADLEY'S BEND, TENN.—The contract for the electrical equipment for the power plant to be erected for the United States government at Hadley's Bend has been awarded to the Western Electric Company. The total cost of the electrical equipment is estimated at $5,000,000.

KNOXVILLE, TENN. — The installation of new electric lamps in the newly acquired territory of Greater Knoxville will soon be completed. Since the work was started last August 446 lamps have been erected.

SEWANEE, TENN.—The telephone exchange building of the Sewanee Telephone Company was recently damaged by fire.

BIRMINGHAM, ALA.—A. T. Newell & Brothers, it is reported, have been awarded the contract for the construction of the Alabama Interurban Railway from Birmingham to the Warrior River, a distance of about 20 miles. Thomas L. Cannon of Birmingham is president of the railway.

KOSCIUSKO, MISS. — The Planters' Oil Mill & Gin Company is contemplating the purchase of coal-handling and unloading machinery.

SHREVEPORT, LA.—The installation of additional equipment is reported to be under consideration by the Elliott Electric Company of Shreveport.

BROKEN ARROW, OKLA.—The Oklahoma Public Service Corporation has applied for a franchise to install an electric light and power plant in Broken Arrow. The granting of the proposed franchise will be submitted to the voters on March 26.

SHATTUCK, OKLA. — Plans are being considered for rebuilding the municipal electric-light plant and water-works system for which bids will soon be asked. The proposed work consists of the installation of either oil fuel or steam plant for lighting system and rebuilding all water mains. The cost is estimated at $75,000.

DALLAS, TEX.—The erection of a new telephone exchange building is under consideration by the consolidated telephone companies. The plans provide for an 18-story building.

EAGLE PASS, TEX.—The Eagle Pass Ice Manufacturing Company is contemplating the installation of additional machinery to cost about $20,000.

HOUSTON, TEX.—Contract has been awarded by the City Council for the construction of the first unit of the proposed municipal street railway from a connection with the International & Great Northern Railroad north of Harrisburg Boulevard to the plant of the Sinclair Gulf & Refinery Company east of Simms Bayou (4 miles), to the Houston Construction Company, at $59,000.

LUBBOCK, TEX. — Extensions are contemplated to the municipal electric light plant, including the installation of an additional 200-hp. oil engine and generator, bids for which will be called for early in April. C. E. Parks is Mayor.

McALLEN, TEX.—The Mutual Irrigation Company contemplates the construction of an irrigation system in this vicinity and also the installation of a pumping plant, to cost about $50,000.

Pacific and Mountain States

KELSO, WASH.—The district office of the North Coast Power Company, formerly at Kalama, will be transferred to Kelso. F. A. Peterson will assume the management of the Kalama office.

RITZVILLE, WASH.—The Intermountain Power Company has petitioned the Commissioners of Adams County for a franchise to erect and operate electric transmission lines over certain highways in Adams County.

SEATTLE, WASH. — The Lighting Department of the city of Seattle has secured a contract to supply 2500 hp. to the shipyards of the Erickson Engineering Company. This company will construct steel ships.

SEATTLE, WASH.—Bids will be received by the purchasing agent of the Alaskan Engineering Commission, 422 Bell Street Dock, until March 25 for furnishing electrical supplies as follows: For 6600 ft. conduit, 40,000 insulators, 25,000 ft. 5/16-in. cable, and approximately 100,000 ft of wire.

SNOHOMISH, WASH.—Mayor J. W. Hall has publicly announced that he is in favor of a movement to utilize water power of the county for municipal electric-light plants, asserting that Snohomish can obtain 5000 hp. from the dam of the city

gravity pipe line. The Commercial Club is also back of the project.

VANCOUVER, WASH.—The Portland Railway, Light & Power Company contemplates an extension of its 11,000-volt commercial feeder line to pick up 2000 hp. steel shipbuilding load. F. H. Gay is division manager.

WALLA WALLA, WASH.—Further improvements are contemplated by the Pacific Power & Light Company to its local system. The company is building a new switching station at Pasco, which when completed will improve the service in Walla Walla.

MORO, ORE. — The Farmers' Elevator & Supply Company of Moro is contemplating the construction of two elevators at Moro, to cost about $70,000. The cost of the equipment is estimated at about $12,000.

PORTLAND, ORE.—What may become the first unit of a municipal power plant is now under construction by the Water Bureau at the headworks of the Bull Run water system. Plans have been prepared for the installation of a 4-kw. electric plant for lighting the buildings at the headworks. L. M. Kaiser, superintendent of the water bureau, has charge of the work.

BISHOP, CAL.—A mill will be built at the camp at the Pine Creek tungsten claims, recently secured by the Cooper Shapely of the Round Valley Tungsten Company. Two Marcy mills with a combined capacity of 150 tons daily will be installed. Arrangements, it is understood, have been made with the Southern Sierras Power Company for furnishing electricity to operate the proposed mills. To furnish the service a transmission line 12 miles long will be erected.

FRESNO, CAL. — Application has been filed by the San Joaquin Light & Power Company with the State Water Commission for 250 second-feet of water in addition to that already used by the company from the Kern River. A new plant to increase its present output by 20,000 hp. is to be erected at the mouth of Kern River Canyon, to cost about $1,500,000.

FRESNO, CAL. — Application has been filed with the State Railroad Commission by the San Joaquin Light & Power Company for authority to issue $1,000,000 in bonds, the proceeds to be used to complete additional facilities upon which work has already started. Among them is plant No. 2, near North Fork.

KNIGHTS FERRY, CAL.—Plans are being considered to reopen the old power plant at Knights Ferry, which was closed down over 12 years ago. The Railroad Commission has asked that this plant be used, as it will be a means of conserving oil. The plant is owned by the Sierra & San Francisco Power Company. H. F. Jackson, 58 Sutter Street, San Francisco, is general manager.

LOS ANGELES, CAL.—Twenty-three ordinances providing for the installation of ornamental lamps on as many thoroughfares have been adopted by the City Council.

LOS ANGELES, CAL.—The Public Service Commission has authorized the leasing from the Harbor Commission of a tract of land on the east side of the Harbor Boulevard, adjoining the Los Angeles Dry Dock & Shipbuilding Company on the west basin, to be used as a site for a substation for the municipal power system. This station will furnish power service to industries around the west basin and to Pier No. 1 and across the channel in the Wilmington district.

OAKLAND, CAL.—All wires in the Lake District between Wesley Avenue and Cottage Street are being placed underground.

RIVERSIDE, CAL.—The Southern Sierras Power Company has petitioned the State Railroad Commission for permission to purchase and incorporate under its management the Corona (Cal.) Gas & Electric Company, the Rialto (Cal.) Light & Power Company and the Bishop (Cal.) Light & Power Company.

VENICE, CAL.—The City Council will advertise the sale of a ten-year franchise to operate an electric railway on the ocean front.

BONNERS FERRY, IDAHO. — John E. Price & Company of Seattle, Wash., have taken an option on the holdings of the Bonner Water & Light Company of Bonners Ferry, the price being placed at $135,000.

TWIN FALLS, IDAHO.—Plans are being considered by the citizens of Twin Falls, Buhl and Filer for establishing a mutually owned electric light and power plant to serve this district. It is proposed to take over the plans and plants of the Mutual Light, Heat & Power Company, recently organized to develop and furnish electricity to its stockholders at cost of production; also taking over the partially developed power site at Clear Lake on Snake River north of Buhl, owned by W. C. Hazzard. A committee has been appointed to enter into negotiations with Mr. Hazzard for the purchase of the property.

BRIGHAM, UTAH.—The electric light committee is contemplating removing the lamp poles from the center of the street to the curb line in the business section of the city. C. O. Roskelly is manager of the municipal electric-light plant.

TOOELE, UTAH. — The Utah Lime & Stone Company is negotiating with the Clark Electric Power Company of Tooele to extend its electric transmission lines to Flux and Dolomite to furnish electricity to operate its factories at those places. The lines of the Clark company now extend within 7 miles of the property of the Utah Lime & Stone Company.

KINGMAN, ARIZ.—Surveys are being made by the Desert Power & Water Company for the proposed extension of its electric transmission lines from the generating station in Kingston to the Hackberry mining district, a distance of 33 miles.

CHESTER, MONT.—A petition is being circulated by the residents of Chester and Joplin to be presented to the Montana Power Company, asking that the electric transmission line of the company be extended from Havre to Shelby, taking in Chester and Joplin. Both towns have electric generating plants, but are unable to meet the demands made upon them.

CASPER, WYO. — The Natrano County Electric Company and the Wyoming Electric Company, both of Casper, have been consolidated under the name of the Natrona Power Company. The concern is capitalized at $1,000,000 and furnishes electricity to the Casper district. Patrick Sullivan of Casper is president; E. P. Bacon of Logan is vice-president and manager.

WHEATLAND, WYO. — Bonds have recently been voted for the installation of a municipal electric-light plant in Wheatland.

YERINGTON, NEV.—Application has been made to the State Water Commission by A. M. Wishart, Alexander Cameron and Jabes Herrin of Yerington to impound 20 second-ft. of the waters of Sweetwater Creek in Mono County. They propose to build a dam 10 ft. high and 48 ft. long, and running from the pool so formed is to be a metallic flume 3 1-2 miles long. It is estimated that 2575 hp. will be developed.

GALLUP, N. M.—The Town Board is considering calling an election to vote on the proposal to establish a municipal electric-lighting plant. An engineer will be employed by the town to estimate cost of plant and other necessary data.

Canada

KASLO, B. C.—The question of establishing a 24-hr. service in connection with the municipal electric-light plant is under consideration. Fred D. Emory is chief engineer.

MURRAYVILLE, B. C.—The Laking Mills, destroyed by fire some time ago, are being rebuilt and will be equipped for electrical operations.

REVELSTOKE, B. C.—The city of Revelstoke is considering putting in new sluiceways and new head racks at dam. Correspondence is invited from contractors and dealers interested in this work. C. North is manager.

TRAIL, B. C.—The West Kootenay Power & Light Company is contemplating the construction of new lines and improvements to its system in Trail and vicinity, involving an expenditure of about $30,000.

VICTORIA, B. C.—Bids are being received by City Purchasing Agent Galt for a supply of globes for arc lamps and nitrogen lamps for the light and power department.

FREDERICTON, N. B.—Application will be made for a charter for the construction of a new car line from the St. John Valley Road at a point near Pokiok to a connection with the proposed Eastern Maine Railway at a point near the international boundary at North Lake in Orient, Aroostook County, a distance of 24 miles. The plans provide for generating and distribution of hydroelectric power. The Eastern Maine Railway Company of Bangor, Me., is reported interested in the project.

HALIFAX, N. S.—The intention of the Dominion government to establish a steel shipbuilding plant at Halifax has been announced by the Department of Public Works. Extensions to drydock and repairs will be made to Piers Nos. 3 and 4, for which contract has been awarded to the Cook Construction Company.

CORNWALL, ONT.—The Board of Trade has sent a resolution to the Hydro-Electric Power Commission of Ontario, the Dominion and Ontario Premiers and Frank Carvell, minister of Public Works, asking that action be taken as soon as possible with reference to the development of Longue Sault Rapids for power purposes.

OTTAWA, ONT.—Tenders will be received by John A. Pearson, architect, and J. O. Marchand, associate architect, Parliament Buildings, Ottawa, Ont., Can., until March 25 for switchboards, panelboards and transformers required in the reconstruction of the Parliament Buildings. Plans and specifications and other information may be obtained at the office of the general contractor, P. Lyall & Sons Construction Company, Ottawa.

PORT DOVER, ONT.—The installation of an electric system (Hydro-Electric power) is reported to be under consideration by the Town Council.

TILSONBURG, ONT.—The main building of the plant of the Huntley Manufacturing Company in Tilson burg was recently destroyed by fire, including machinery, tools and completed elevator machinery, causing a loss of several hundred thousand dollars. The main plant of the company is located at Silver Springs, N. Y.

TORONTO, ONT.—The Alloy Steel Works are reported to be considering the installation of a six-ton electric furnace in the near future.

TORONTO, ONT. — The government of Ontario has appropriated $9,054,000 for hydroelectric development in this Province. Of this $4,175,000 is for Niagara Falls development, including the Chippewa-Queenston project, and $2,896,000 for extensions to the Niagara Falls system, which includes the radial railway from Welland to Port Colborne, to Fort Erie and Bridgeburg. The Hydro-Electric Commission, it is expected, will not require all this amount in 1918. The Chippewa-Queenston power canal, it is hoped, will be completed by 1921. The radial lines, it is understood, will not be built during the war.

TORONTO, ONT.—Plans have been prepared by the Imperial Oil Company, 56 Church Street, Toronto, for the erection of a pump house, to cost about $5,000, and a boiler house, to cost $10,000.

MONTAGUE, P. E. I.—The Montague Electric Company is being reorganized. The capital stock has been increased from $10,000 to $25,000 and new machinery installed in the plant. Work on improvements has not yet been fully completed and considerable house wiring is yet to be done.

MONTREAL, QUE.—The Southern Canada Power Company is contemplating the purchase of a 150-kw. and a 300-kw. motor-generator set (second hand), the generator end 250 volts, direct current, motor end three phase, 60 cycles, 220 volts, synchronous motor, or separate machines of identical capacities and characteristics. L. C. Haskell is purchasing agent.

ST. LAMBERT, QUE.—Work, it is understood, will be started this summer on the new plant of the Dominion Textile Company. The cost of the building is estimated at $3,000,000.

THREE RIVERS, QUE.—Prices are being asked by the city of Three Rivers on a 3000-gal. centrifugal pump, split case, one-stage, and a 200-hp. gasoline engine.

VERDUN, QUE. — Improvements are contemplated to the municipal electric-light plant and waterworks system to cost about $50,000, for which, it is understood, bids will soon be asked.

MELFORT, SASK.—The purchase of a Diesel engine is under consideration by the Town Council.

MOOSE JAW, SASK.—The Council has appropriated $20,400 for extensions to the municipal electric power plant as recommended by J. D. Peters, manager.

MOOSE JAW, SASK.—The Canadian Pacific Railway Company contemplates the erection of a mechanical coaling plant (400 tons capacity) in Moose Jaw, rebuilding and adding to the local stock yards; building new section houses, tool houses, stations, wells, and the grading of siding and road crossings in the yards west of the city.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until April 1 for lighting fixtures, bronze wire, annunciators, signal bells, connectors, push-buttton plates, reflectors, switches, conduletes and covers, shades, fans, bends, cleats, conduits, elbows, oil heaters, oil pump, etc. Blanks and information relating to this circular (No. 1207) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 606 Common Street, New Orleans, La., and Fort Mason, San Francisco, Cal.

(Issued Feb. 12, 1918.)

1,256,319. Electrolytic Cell; Thomas G. Hitt, Seattle, Wash. App. filed Oct. 26, 1916. Transforms chlorides into perchlorates.

1,256,322. Semi-Automatic Telephone Exchange; Carl A. W. Hultman, Stockholm, Sweden. App. filed March 18, 1916. Simplifies circuits and switching means so as to obtain reliance operation and a quick connection of the register with the junction.

1,256,332. Switch Mechanism; Hubert F. Krantz, Brooklyn, N. Y. App. filed May 5, 1914. For use with either a push-button, lever throw or pull switch, particularly of the quick-make and quick-break type.

1,256,343. Elevator Signal System; Alvin C. McNabb, Dallas, Tex. App. filed Oct. 23, 1915. Improvements.

1,256,362. Automatic Headlight Dimmer for Automobiles; Victor Olson, Naugatuck, Conn. App. filed March 24, 1916. Improved.

1,256,380. Mercury Switch; Frederick W. Schmidt, Chicago, Ill. App. filed Oct. 19, 1914. Improvement.

1,256,405. Rotary - Blower Spark Gap; Harlan S. Webster, Canton, Ohio. App. filed March 3, 1917. Means for cooling the electrodes.

1,256,447. Typewriter Attachment; David E. Dunkle, Norwich, Pa. App. filed April 28, 1916. Electrically operated carriage shifters for typewriters.

1,256,500. Telephone-Exchange System; Henry P. Clausen, Mount Vernon, N. Y. App. filed April 27, 1916. Operation of a line-finder switch in hunting for a calling line will be inaudible to busy lines multiplied to the same group.

(Issued Feb. 19, 1918.)

1,256,511. Automatic Telephone Switch; John G. Blessing and Bernard D. Willis, Chicago, Ill. App. filed March 16, 1912. Improved automatic switch and circuits for operating the same.

1,256,512. Substation Switch Hook; John G. Blessing, Chicago, Ill. App. filed March 20, 1916. For automatic telephone systems.

1,256,545. Door-Lock-Controlled Electric Switch; John R. Folger, Detroit, Mich. App. filed Feb. 26, 1916. Designed to cut out the lights in a room when the door is locked.

1,256,546. Wall Switch; Charles Forth, Ottawa, Ontario, Canada. App. filed Feb. 2, 1916. Improvements.

1,256,554. System of Wireless Telephony; Walton Harrison, New York, N. Y. App. filed Oct. 30, 1914. Improvements.

1,256,558. Motor Vehicle; Frederic Hild, Denver, Col. App. filed Oct. 2, 1916. Improvements in various features of construction, including novel mountings for the wheel trucks, wheels and motors.

1,256,567. Incandescent Lamp with Concentrated Metallic Filament; Herman J. Jaeger, Weehawken, N. J. App. filed March 16, 1915. Improvements.

1,256,568. Metallic-Filament Lamp Filled with Nitrogen; Herman J. Jaeger, Weehawken, N. J. App. filed March 17, 1916. Improvements.

1,256,571. Electric Heating Device; William K. Kearsley, Jr., Newark, N. J. App. filed Aug. 17, 1916. Cigar lighter.

1,256,587. Telephone System; Earl R. Neir and Bernard C. Groh, Chicago, Ill. App. filed March 20, 1916. Improvements.

1,256,591. Means for Indicating the Display of Motion Pictures; Robert D. Pike, San Francisco, Cal. App. filed July 17, 1916. Improvements.

1,256,616. Electropneumatic Brake; Walter V. Turner, Wilkinsburg, Pa. App. filed July 27, 1915. Relates to fluid-pressure brakes.

1,256,618. Fluid-Pressure Brake Device; Walter V. Turner, Wilkinsburg, Pa. App. filed March 28, 1917. Electrically controlled.

1,256,623. Reduction of Ores; Sigurd Westberg and Emil Edwin, Christiania, Norway. App. filed Aug. 26, 1916. Relates to the reduction of oxide ores by means of reducing gases.

1,256,628. Electrical System of Distribution; Joseph Woodbridge, Philadelphia, Pa. App. filed June 9, 1914. Storage battery is employed for supplying current to the circuit when the dynamo is shut down.

1,256,643. High-Tension Suspension Insulator; Svend Barford, Oakland, Cal. App. filed July 26, 1915. Provides an insulator in which fracture from shearing strain is entirely eliminated.

Record of Electrical Patents

Notes on United States Patents

1,256,665. Circuit Coupling; Harry A. Douglas, Bronson, Mich. App. filed March 17, 1916. Improved union between a coupler or connector and the lug or member which is desirably provided therefor.

1,256,691. Electric Lighting Apparatus; William H. Honsberger, Welland, Ontario, Canada. App. filed July 30, 1917. Switch-controlled headlight circuit.

1,256,692. Electric Switch; William H. Honsberger, Welland, Ontario, Canada. App. filed July 30, 1917. Vehicles.

1,256,698. Telephone-Exchange System; Lewis H. Johnson, Bloomfield, N. J. App. filed May 25, 1917. Improved signaling means.

1,256,705. Induction Motor; Justin Lebovici, Oakley, Ohio. App. filed June 2, 1916. Self-starting type.

1,256,708. Transmitter; Eugene H. Lowe, Modesto, Cal. App. filed Jan. 23, 1917. Resistance-varying elements are disposed in a vacuum chamber.

1,256,732. Recording Mechanism for Railway - Traffic - Controlling Apparatus; Frank H. Nicholson, Wilkinsburg, Pa. App. filed Aug. 27, 1914. Improvements.

1,256,740. Fire Alarm; Eugen Steiger, Zürich, Switzerland. App. filed April 22, 1916. Consists of the light box, sources of electricity, an electrically controlled switch or relay, and the audible or visible alarm device proper, or an extinguisher, such as a water-sprinkler system or the like.

1,256,749. Incandescent - Lamp Fixture; William C. H. Wefel, Denver, Col. App. filed Dec. 14, 1916. Designed for use in a circuit in which a number of lamps are connected in series.

1,256,758. Process of Refining Sugar; Robert R. Williams, Manila, Philippine Islands. App. filed Jan. 26, 1914. Pertains to an electrolytic process for the removal of any acids, bases or salts (electrolytes) from solutions of sugar for the purpose of increasing the purity of the sugar solution and facilitating further utilization.

1,256,795. Multipolar Magneto; Otto Heins, New York, N. Y. App. filed Dec. 24, 1915. Improvements.

1,256,796. Multipolar Magneto; Otto Heins, New York, N. Y. Improvements.

1,256,800. Circuit Controller; Albert J. Horton, White Plains, N. Y. App. filed Feb. 5, 1912. Controlled by a common electromagnet.

1,256,802. Process of Extracting Zinc from Its Ores; Edvin A. Johansson, Trollhättan, Sweden. Improvements.

1,256,804. Magnet - Grouping Device for Electrical Musical Instruments; John F. Kelly, Pittsfield, Mass. App. filed Sept. 24, 1912. Type in which a perforated note or music sheet is employed to control the operation of the electromagnets.

1,256,813. Connecting Member for Electrical Conductors; Harry T. Martin, Milwaukee, Wis. App. filed Oct. 27, 1916. Improvements.

1,256,814. Permutation Electric Switch; Sigurd O. Mattison, Eau Claire, Wis. App. filed Dec. 4, 1916. May be actuated to connect two of a series of contact members selectively.

1,256,817. Automatic Telephone System; Frank Newforth, Jr., Chicago, Ill. App. filed Sept. 18, 1914. Improvements.

1,256,832. Fluid Rheostat; Michael N. Schonwitz, Milwaukee, Wis. App. filed June 26, 1916. Fluid or electrolytic type.

1,256,842. System of Control; Norman W. Storer, Pittsburgh, Pa. App. filed Nov. 12, 1915. Regenerative.

1,256,863. Electric Conductor; Charles J. Beaver and Ernest A. Claremont, High Leigh, England. App. filed July 19, 1915. Saves the waste of copper involved in enlarging the cross-section area of the cable and at the same time secures, on the one hand, the necessary flexibility and, on the other hand, the security from distortion necessary in a high-voltage cable.

1,256,864. Composition of Matter; Julius Becker, Chicago, Ill. App. filed Nov. 27, 1916. Well adapted for use as a separation material for plates in electric secondary cells and the like.

1,256,875. Process for Producing Ammonia; Alexander Classen, Aix la Chapelle, Germany. App. filed Oct. 8, 1915. Operates by the action of electric discharges.

1,256,889. Wireless Duplex Signaling System; Lloyd Espenschied, Hollis, N. Y. App. filed May 15, 1916. Provides a system for the simultaneous transmission and reception of signals and in particular to afford means for duplex communication between two stations.

1,256,912. Continuous - Current Generator; Frans G. Liljenroth, Westeras, Sweden. App. filed May 20, 1916. Applies particularly to shunt or separately excited generators of that type.

1,256,929. Process of Producing Metallic Wires, Filaments and the Like; Otto Schaller, Berlin, Germany. App. filed May 16, 1914. Improved.

1,256,930. Filament of Wire Formed of a Single Crystal; Otto Schaller, Berlin, Germany. App. filed May 16, 1914. Produced in passing a crystalline or a fibrous structure, through a short zone of intense heat, at a certain speed.

1,256,935. Process of Producing Nitrogen Compounds of Metals; Mathias Sem, Christiania, Norway. App. filed Nov. 21, 1916. Operates by the action of gaseous nitrogen upon carbides and has for its object a continuous process of producing such compounds by producing a suspension or cloud of pulverulent carbide in a current of gaseous nitrogen.

1,256,950. Accelerator; John E. Thompson and Clarence W. Jameson, Chicago, Ill. App. filed Oct. 7, 1915. Used in connection with the control of elevator motors and the like.

1,256,951. Cooling Spot - Welding Electrode; Elihu Thomson, Swampscott, Mass. App. filed May 29, 1917. Improvements.

1,256,958. Electric Heating Furnace; Edward E. Walker and John W. Cox, Erie, Pa. App. filed Jan. 2, 1917. A liquid electrode is utilized which diffuses the intense heat of the arc, thus prolonging the life of the electrode and so extending the heat area as to make it effective as a heating unit.

1,256,959. Metho[illegible] Heating; Edward E. Walker and John W. Cox, Erie, Pa. App. filed Feb. 15, 1917. Utilizes an electric arc.

1,256,960. Protective Arrangement for Electrical Systems; John F. Watson, Blackheath, England. App. filed Nov. 24, 1915. Consists of an arrangement of pilot or protective conductors and relays so interconnected or associated with one another that, while normally there is no complete circuit through any of the protective conductors, current derived by one conductor from the system through leakage which virtually establishes the circuit of a companion relay controlling a switch at one place will, through such relay, cause current to be conducted to the conductor or conductors of other relay or relays controlling a switch or switches at a distance.

1,256,969. Temperature-Control System; Frank Ahlburg, San Francisco, Cal. App. filed Nov. 4, 1915. Particularly adapted for use in an apparatus for marking fruit.

1,256,972. Separation of Magnetic Iron Ore from the Associated Non-Magnetic or Feebly Magnetic Minerals; App. filed May 10, 1911. Improvements.

1,256,983. Wireless Telegraphy and Telephony; Edwin H. Colpitts, East Orange, N. J. App. filed Jan. 27, 1916. Improved method for the simultaneous transmission of telephone and telegraph signals and for their reception.

1,257,015. Electric Lighting System for Automobiles; Bernice J. Noyes, Boston, Mass. App. filed April 9, 1913. Improvements.

1,257,021. Reloadable Fuse; Ralph C. Patton, Providence, R. I. App. filed June 20, 1917. Strong enough to operate safely without filling material.

1,257,054. Electric-Wire Coupling; Courtland W. Weaver, Toronto, Ontario, Canada. App. filed June 19, 1917. Improvements.

1,257,075. Reproduction of Sound Characteristics; Percy W. Fuller, Boston, Mass. App. filed Sept. 30, 1910. Operates somewhat after the manner of a condenser.